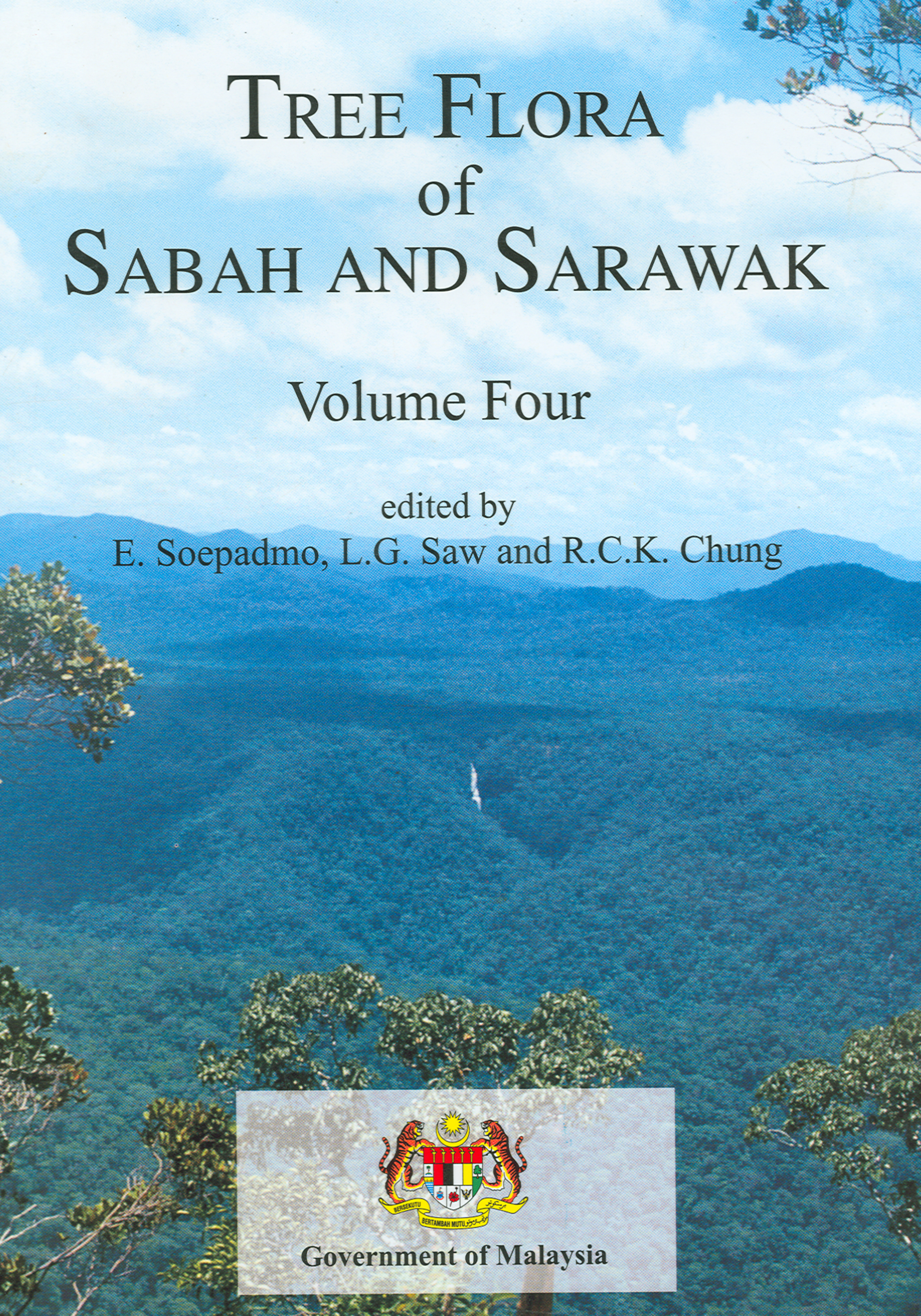

TREE FLORA of SABAH AND SARAWAK

Volume Four

edited by
E. Soepadmo, L.G. Saw and R.C.K. Chung

Government of Malaysia

TREE FLORA
of
SABAH AND SARAWAK

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Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E.Soepadmo.)

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FOREWORD

The appearance of *Tree Flora of Sabah and Sarawak* Volume 4, about one and a half years after the publication of the third volume in August 2000, is indeed a good sign that the project is progressing well. Particularly gratifying is the involvement of a number of local botanists attached to the Forest Research Institute Malaysia (FRIM) and the Forestry Departments of Sabah and Sarawak. We are most happy to note that this volume includes accounts of a number of families for which there is no recent regional revision. We believe that this is the fruit of various training courses organised by the *Tree Flora of Sabah and Sarawak Project* for the local botanists to tackle some of the more difficult families. The benefits of such training have gone beyond the *Tree Flora of Sabah and Sarawak Project*. Many of these botanists are now actively contributing to other regional projects, such as the *PROSEA* and *Guide to Brunei Trees Projects*. We shall continue to support the efforts by the team and hope that such active participation of both local and regional botanists in the projects can be sustained.

This volume contains accounts of six medium-sized and large families contributed by different authors. These are: Aquifoliaceae by Susyn Andrews of the Royal Botanic Gardens, Kew; Ebenaceae by Francis S.P. Ng of FRIM; Lecythidaceae by Michelle A. Pinard of the University of Aberdeen; Oleaceae by Ruth Kiew of the Singapore Botanic Gardens; Proteaceae by R.C.K. Chung of FRIM; and Sapotaceae by P.P.K. Chai and P.C. Yii, with contributions by A.P. Abang Mohd. Mohtar, L.C.J. Julaihi, M. Mohizah, A. Noorsiha, J.T. Pereira, and Stephen P. Teo of FRIM, Forestry Department of Sabah and Forestry Department of Sarawak. Of these, only the Proteaceae had been revised by Sleumer in 1955 (Flora Malesiana 1, 5). More significantly, members of the Ebenaceae and Sapotaceae are important sources of tropical timbers for Sabah and Sarawak. This volume provides detailed and up-to-date botanical information on 24 genera and 321 species supplemented with 64 line drawings of representative species. It has also made many new discoveries and given us better understanding of the diversity of tree species in Borneo. Among some of the findings are: 45 species (or about 14%) are new to science, 149 (or about 46.5%) are endemic to Borneo, 69 (or about 21.5%) are endemic to Sabah and/or Sarawak, and 45 (or about 14%) are rare species, i.e., known only by one or two collections or confined to specific habitats or with their distribution limited to one or two localities in Sabah and Sarawak.

Results published in this volume, demonstrate once again that continuous effort and well coordinated research on the *Tree Flora of Sabah and Sarawak* will yield valuable information pertaining to the species diversity, distribution and conservation status of tree resources of Sabah and Sarawak. In conjunction with similar studies carried out in Central and East Kalimantan (Kessler & Sidiyasa, 1994; Argent *et al.*, 1997), Brunei Darussalam (Coode *et al.*, 1996) and Mount Kinabalu Sabah (Beaman *et al.*, 2001), the continuation and completion of the *Tree Flora of Sabah and Sarawak Project* is of vital importance to our understanding of the biological diversity of the species-rich Borneo Island. To achieve such a goal, there is a need for closer collaboration between botanists and botanical institutions in the region as well as at international level. It is well known that while most of the biological diversity of the world is located in the tropics, the expertise and adequate facilities (herbaria, libraries and museums) are largely concentrated in extra-tropical countries. Compounding this problem is the fact that in a developing country such as Malaysia, the area of species-rich natural forest is declining rapidly, and funding for basic botanical research is often not readily forthcoming. In this context, we are deeply indebted to the Malaysian Federal Government, the State Governments of Sabah and Sarawak, and the Malaysian Forestry Research and Development Board for the research grants for the 2000–2001 fiscal year. Without such a grant, the preparation and publication of the *Tree Flora of Sabah and Sarawak* Volume 4 would not have been possible.

We are very much obliged to the Directors/Heads of various national and international botanical institutions for their invaluable help and co-operation, and to members of the Editorial Advisory Committee for making the publication of *Tree Flora of Sabah and Sarawak* Volume 4 a reality. We would like to take this opportunity to congratulate the editors of this volume for their hard work and dedication, and to express our deepest appreciation to the botanists and botanical artists for a job well done. Finally, we are also very grateful to a number of staff of the Forest Research Institute Malaysia and the Forestry Departments of Sabah and Sarawak for their continuous assistance and support.

Dato' Dr. Abdul Razak Mohd. Ali
Director-General
Forest Research Institute Malaysia

Mr. Daniel Khiong Kok Sin
Director
Sabah Forestry Department
Malaysia

Mr. Cheong Ek Choon
Director
Sarawak Forestry Department
Malaysia

January 2002

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Once again, it gives us great pleasure to acknowledge the help and co-operation rendered by various institutions and individuals in the course of the preparation and publication of the *Tree Flora of Sabah and Sarawak* volume 4. In particular, we are deeply indebted to the Federal Government of Malaysia as well as to the State Governments of Sabah and Sarawak for the much needed research grants. Tan Sri G.K. Rama Iyer and Datuk Lim Chong Keat, the former and current Chairman of the Malaysian Forestry Research and Development Board; Dato' Dr. Abdul Razak Mohd. Ali, Director-General of the Forest Research Institute Malaysia; Mr. Daniel Khiong Kok Sin, Director of the Sabah Forestry Department, and Mr. Cheong Ek Choon, Director of the Sarawak Forestry Department have provided guidance, leadership and encouragement to the project.

The Directors/Keepers/Curators of the Herbarium Bogoriense (BO), Herbarium, Department of Botany, the British Natural History Museum, London (BM), Herbarium of the Royal Botanic Gardens, Kew (K), Herbier, Laboratoire de Phaneorgamie, Museum National de'Histoire Naturalle, Paris (P), Herbarium, Forestry Department, Bandar Seri Bengawan, Brunei Darussalam (BRUN), Herbarium of the Forest Research Institute Malaysia (KEP), National Herbarium of the Netherlands, Leiden Branch (L), Herbarium of the Forestry Department of Sabah (SAN), Herbarium of the Forestry Department of Sarawak (SAR), Herbarium of the Singapore Botanic Gardens (SING), and a few others have generously given permission to the project botanists to obtain information and services available at their institutions, and facilitated loans of specimens.

Prof. P.S. Ashton (Harvard University, U.S.A.), Dr. J. Dransfield (Royal Botanic Gardens, Kew, U.K.), Dr. T.C. Whitmore (University of Cambridge, U.K.), and Dr. W.J.J.O. de Wilde (National Herbarium of the Netherlands, Leiden Branch, the Netherlands) provided valuable advice and guidance on various editorial matters. Dr. J.F. Veldkamp (National Herbarium of the Netherlands, Leiden Branch), Mr. M.J.E. Coode (Herbarium of the Royal Botanic Gardens, Kew) and Prof. Christian Puff (University of Vienna, Austria) kindly provided Latin diagnoses of new taxa of *Chionanthus* (Oleaceae), *Diospyros* (Ebenaceae), *Helicia* and *Heliciopsis* (Proteaceae), and *Madhuca* and *Payena* (Sapotaceae) published elsewhere. We are extremely grateful to Dr. W. Vink (National Herbarium of the Netherlands, Leiden Branch) for his critical and constructive comments on the manuscript of the Sapotaceae.

We gratefully acknowledge the help, support and encouragement from Prof. P. Baas and Dr. Marco Roos (National Herbarium of the Netherlands, Leiden Branch), Dr. P. Bacon (Oxford Forestry Institute, University of Oxford, U.K.), Prof. Abdul Latiff Mohamad (Universiti Kebangsaan Malaysia), Dr. H.S. Lee (Sarawak Forestry Department), Dr. Sining Unchi and Mr. Robert Ong (Sabah Forestry Department), and Dr. S.C. Chin and Dr. Ruth Kiew (Singapore Botanic Gardens).

At home institutions, we would like to express our appreciation to many who have given support and encouragement; they are, at Kepong: Dato' Dr. Wan Razali Wan Mohd., Dr. N. Manokaran, Dr. Abdul Rahim Nik, Dr. H.T. Chan, Dr. Francis S.P. Ng, Dr. Lillian S.L. Chua, Ms. Noorsiha Ayop, Mr. Mat Asri Ngah Sanah, Mr. Kamarudin Saleh, Mr. Damahuri Sabari, Mrs. Zainun

Othman, Mrs. Asnah Hashim, and Mrs. Saripah Barom; in Sabah: Mrs. J.T. Pereira, Mr. J.B. Sugau, Mr. S.P. Lim, Mr. Leopold Madani, and Mr. Dewol Sundaling; and in Sarawak: Ms. Lucy Chong, Dr. Paul P.K. Chai, Mr. P.C. Yii, Mr. A.P. Abang Mohd. Mohtar, Mrs. Runi S. Pungga, Mr. L.C.J. Julaihi, Mr. Stephen P. Teo, and Ms. Mohizah Mohamad.

Finally, we would like to record our deepest gratitude to Ms. Rosemary Wise (Oxford Forestry Institute), Mr. Joseph Pao (Sarawak Forestry Department), Mr. Mohd. Nizam Isa (Universiti Kebangsaan Malaysia), Madam Yap Pak Hau (Sabah Forestry Department), and Mr. Zainal Mustafa (University of Malaya) for meticulously preparing the illustrations, and to congratulate as well as to thank the botanists for their excellent contributions.

E. Soepadmo
L.G. Saw
R.C.K. Chung

January 2002

DEDICATION

Timothy Charles Whitmore

(9th June 1935–14th February 2002)

This volume is respectfully dedicated to the memory of Timothy Charles Whitmore whose exemplary initiative, drive and dedication towards the *Tree Flora of Malaya* project had greatly inspired the current work on the *Tree Flora of Sabah and Sarawak.* At the age of 66 years, Tim passed away peacefully on the 14th February 2002 in Cambridge, United Kingdom. We, the botanical community in Malaysia, are deeply indebted to his invaluable contribution towards the advancement of botanical and ecological knowledge of tropical rain forest of the Malesian region.

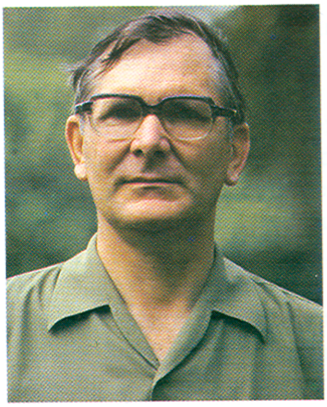
E. Soepadmo
L.G. Saw
R.C.K. Chung

Kuala Lumpur
27th February 2002

Tim Whitmore and the Tree Flora of Malaya

Tim was funded by the British Government under the Colombo Plan assistance programme to initiate the *Tree Flora of Malaya* and to train Malaysian counterparts in botanical research. Tim worked a total of 6 years on the Tree Flora Project, beginning in September 1965, and producing the first two volumes.

Originally the Tree Flora was to be called the *Forester's Manual of Non-Dipterocarps*, to complement C.F. Symington's *Forester's Manual of Dipterocarps* (published during the Japanese Occupation of Malaya). Tim calculated that the 'non-dipterocarp' manuals would be four times as voluminous as the dipterocarp manual and deserved a more positive title. After persuading the Forest Department to accept the title "*Tree Flora of Malaya*" he next persuaded the Department to have the book published commercially, by an international publisher, Longman. This was an unheard-of arrangement at that time, but Tim was very persuasive. As a result, the *Tree Flora of Malaya* did not cost the Government any money to print, was stocked by bookshops in Malaysia and overseas through three print runs, and paid a 10% royalty to Government every year.



Tim also broke new ground in visualising the *Tree Flora of Malaya* as a multi-author work, which meant getting K.M. Kochummen and myself trained for the work, and persuading other botanists elsewhere to contribute chapters.

In the 1960s, many parts of Peninsular Malaysia were just becoming accessible through the construction of new roads, so one of Tim's priorities was to organise a big plant collection effort, concentrating on new areas that had not been collected before. The plant collecting team was expanded by the recruitment of youngsters from the Orang Asli aboriginal community at Bukit Lanjan. Tim, Kochummen and I spent about a week every month collecting in the field. The revision of families for Volume 1 was begun immediately, based on materials available at Kepong and Singapore.

The *Tree Flora of Malaya* remains unique in being one of the few post-colonial floras to have been completed. Its completion was a tribute to the way in which Tim organised the work, put his reputation on the line, and set the precedents.

Tim, Wendy, and their children were housed in a big colonial bungalow (FD 15) at the far end of the arboretum of the Forest Research Institute in Kepong. The bungalow is now a nature study centre.

Tim was a big man with a booming voice and a ready laugh. He worked hard. Often, I would give him a paper to read, and he would promise to read it "at lunchtime". Sure enough, he would be ready to discuss it after lunch. Tim was highly disciplined, but he made tropical botany interesting rather than intimidating, following the tradition of Corner and Holttum, whom he joins in the gallery of illustrious British-Malayan botanists.

Kuala Lumpur
27th February 2002 Francis S.P.

AQUIFOLIACEAE

Susyn Andrews

Royal Botanic Gardens, Kew,
England, United Kingdom

Miquel, Fl. Ned. Ind. 1, 2 (1859) 593; Hooker *f.*, Fl. Brit. Ind. 1 (1875) 598; King, J. As. Soc. Beng. 64, 2 (1895) 133; Loesener, Monog. Aquifol. 1 (1901) 5; Ridley, FMP 1 (1922) 437; Browne, FTSB (1955) 200; Backer & Bakhuizen *f.*, FJ 2 (1965) 51; Meijer, Bot. News Bull. Herb. For. Dept. 9 (1967) 89; Kiew, TFM 3 (1978) 1; Anderson, CLTS (1980) 150; Mabberley, PB (1987) 18; Corner, WSTM 3rd. edition 1 (1988) 162; Keng, Conc. Fl. Sing. (1990) 114; Turner, Gard. Bull. Sing. 47 (1995) 131; Coode *et al.* (eds.), CLBD (1996) 30; Argent *et al.* (eds.), MNDT-CK (1997) 85; Beaman *et al.*, PMK 4 (2001) 114.

Trees, shrubs, rarely climbers, evergreen or less often deciduous. **Stipules** minute, caducous. **Leaves** simple, alternate, rarely opposite or subopposite, coriaceous to chartaceous, punctate or epunctate beneath, margins entire, serrate or serrulate, rarely crenate. **Inflorescences** axillary, cymose, spicate, racemose, fasciculate or flowers solitary. **Flowers** small, radially symmetrical, unisexual (plants dioecious); sepals 4–6(rarely more), fused at base, rarely free, persistent or semideciduous; petals (3–)4–8(–23) imbricate, fused at base or rarely free; stamens usually the same number as petals, alternate and slightly adherent to petals or free, anthers introrsely and longitudinally dehiscent; disk absent; ovary superior, 4–6(–23)-loculed, style short or absent, stigma capitate, mammiform or discoid, rarely cristate, ovules 1(–2) per locule, pendent from the apex. **Fruit** a berry-like drupe containing 1–12(–23) pyrenes (nutlets). **Seeds** pendulous surrounded by a stony endocarp; endosperm abundant, fleshy; embryo minute and straight.

Distribution. One genus, *Ilex*, with over 400 species and a discontinuous cosmopolitan distribution. Another genus, *Nemopanthus* Raf., has recently been reduced to synonymy of *Ilex* (Powell *et al.*, Kew Bull. 55 (2000) 341).

Ecology. From sea level including mangrove and peat swamp to montane forests, at altitudes to 3500 m.

Uses. Many *Ilex* taxa are of horticultural importance and are widely grown in parks and gardens for their foliage and decorative fruits. There are some 60 species whose leaves are used for beverages and the most widely known is *I. paraguariensis* J.St.-Hil., native to Argentina, Paraguay, Uruguay, and Brazil. Many species are used medicinally, while the wood is of local importance.

Taxonomy. A monograph of the Aquifoliaceae was written by Loesener *l.c.* (1901). Three small genera *Phelline* Labill., *Sphenostemon* Baill. and *Oncotheca* Baill. were once included in the Aquifoliaceae but they are now considered as separate families.

ILEX L.

(from the Latin name for the holm oak, *Quercus ilex* L.)

kerdam (preferred name), *kuku nglipan* (Iban), *peka* (Kayan),
sapo (Bidayuh, Bau), *sulau kelap* (Kenyah), *topu* (Bidayuh, Padawan)

Sp. Pl. 1 (1753) 125; Miquel, Fl. Ned. Ind. 1, 2 (1859) 594; Hooker *f.*, Fl. Brit. Ind. 1 (1875) 598; King, J. As. Soc. Beng. 64, 2 (1895)133; Loesener, Monog. Aquifol. 1 (1901) 8; Backer & Bakhuizen *f.*, FJ 2 (1965) 52; Anderson, Trees Peat Swamp Forests (1972) 25, CLTS (1980) 150; Kiew, TFM 3 (1978) 1; Mabberley, PB (1987) 290; Coode *et al.* (eds.), CLBD (1996) 30; Argent *et al.* (eds.), MNDT-CK (1997) 85; Beaman *et al.*, PMK 4 (2001) 114.

Trees, erect or scandent shrubs, rarely climbers or epiphytes. **Leaves** evergreen, rarely deciduous, alternate, rarely opposite or subopposite. Sepals fused at base, persistent; petals imbricate and fused at base; stamens slightly adherent to corolla. Other foliage, floral, fruit and seed characters as for the family.

Distribution. There are some 120 species of *Ilex* known from South East Asia, with 35 species presently recorded from Sabah and Sarawak.

Ecology. As for the family.

Uses. A limited number of *Ilex* species furnish timber for local industry. A few species are used medicinally, while none of the SE Asian taxa are used horticulturally.

Key to *Ilex* species

1. Leaves subopposite or opposite. 2
Leaves alternate. 5

2. Leaves punctate below, base attenuate or cuneate, apex emarginate or retuse. Inflorescences racemose or spicate. 3
Leaves epunctate below, base subcordate, cordate to amplexicaul, apex acute or mucronate. Inflorescences in compound cymes. 4

3. Twigs glabrous, dark brown. Leaves bullate, spathulate or obovate, 6–7.5 × 3–5 cm, base attenuate, apex emarginate; lateral veins 6–8 pairs; petiole glabrous, 0.7–0.8 cm long. Inflorescences spicate. .... **14. I. mesilauensis**
Twigs puberulous, greyish brown. Leaves not bullate, obovate or oblong-ovate, 3.5–6.5 × 2–4.5 cm, base cuneate, apex retuse; lateral veins 3–5 pairs; petiole puberulous, *c.* 0.2 cm long. Inflorescences racemose. .... **17. I. orestes** (in part)

4. Leaves sessile, broadly elliptic to oblong-elliptic or broadly ovate, (4.5–)7–16(–20) × (3–)5–8.5(–10.5) cm, base cordate to amplexicaul. .... **16. I. oppositifolia**
Leaves with petiole 0.2–0.7 cm long, ovate, obovate or elliptic, (1.5–)4–7 × 1.5–4.5 (–5) cm, base subcordate. .... **22. I. zygophylla**

5. Leaves sessile or subsessile. 6
Leaves petiolate. 7

6. Terrestrial shrubs to 2.5 m tall. Leaves thickly coriaceous, epunctate below, apex acute. Inflorescences in axillary compound cymes. ....

I. laurocerasus Airy Shaw

(Latin, *laurus* = laurel, *cerasus* = cherry tree; with leaves like those of *Laurus*, and fruits resembling cherry)

Bull. Misc. Info., Kew 9 (1939) 509; Masamune, EPB (1942) 415; Anderson *l.c.* (1980) 151; Coode *et al.* (eds.) *l.c.* 30. Type: *Native Collector 1939*, Borneo, Sarawak, Ulu Koyan (holotype K; isotype S).

Terrestrial shrub to 2.5 m tall. Leaves alternate, *thickly coriaceous*, glossy and glabrous above, dull brown below when dried, *epunctate below*, *subsessile*; broadly oblong-elliptic, 12–21 × 5.5–9 cm, base rounded or cordate, margin entire, somewhat revolute, *apex acute*; petiole glabrous. *Inflorescences* puberulous, *in axillary compound cymes*. Male flowers 4–5-merous, white; female flowers and fruits not seen.

Found in forest on sandy soils. Endemic to Borneo. In Sarawak, recorded only from Ulu Koyan (*Native Collector 1939*). Also found in Brunei (e.g., *BRUN 1175* and *BRUN 1280*).

Epiphytes. Leaves coriaceous, punctate below, apex acuminate. Inflorescences or infructescences spicate..

I. apiensis S.Andrews

(of G. Api, Sarawak)

Sandakania 11 (1998) 1. Type: *Anderson S 29878*, Borneo, Sarawak, G. Api (holotype SAR; isotypes A, E, K, L, SING).

Epiphyte. *Leaves alternate*, *coriaceous*, glabrous and dull brown when dried, *punctate below*, *sessile*; oblong to broadly oblong, 10–15 × 6–8 cm, base rounded or cordate, margin entire, *apex acuminate*. Inflorescences unknown. *Infructescences* glabrous, *spicate*. Fruits (immature) globose, pubescent, *c.* 4.5 mm in diameter, green ripening to purple-red; pyrenes 5, round and lineate.

Found in primary forest on limestone hills. Endemic to Borneo; recorded only from G. Api in Sarawak (*S 29878*). Previously identified as *Ilex* sp. 10 in many herbaria.

7. Leaves subchartaceous to chartaceous...8
Leaves subcoriaceous to thickly coriaceous..10

8. Leaves epunctate and somewhat glaucous below, base obtuse; petiole glabrous. Inflorescences in lax compound cymes. Fruits always ribbed when dried; pyrenes 8–10, deeply sulcate.. **5. I. cymosa**
Leaves punctate and not glaucous below, base acute, rounded or cordate; petiole puberulous or pubescent. Inflorescences in fascicles or few-flowered cymes or spicate. Fruits not ribbed when dried; pyrenes 5–8, shallowly sulcate or striate.................................9

9. Twigs glabrous. Leaves elliptic or lanceolate, 6–9.2 × 2–3.4 cm, base acute, apex caudate and obtuse; petiole 0.5–0.8 cm long. Inflorescences in fascicles or few-flowered cymes. Fruits 4–4.5 mm diameter...**3. I. celebensis**
Twigs pubescent. Leaves ovate-elliptic to ovate-oblong, 7–15 × 3–5 cm, base rounded

or cordate, apex acuminate; petiole 0.8–1.3 cm long. Inflorescences spicate. Fruits 2–2.5 mm diameter………………………………………………… **4. I. cissoidea**

10. Leaves epunctate below…………………………………………………………11
Leaves punctate below or on both surfaces………………………………………17

11. Leaves larger, 19–35 × 5.5–13 cm. Inflorescences in axillary compound cymes………. ……………………………………………………………………**13. I. megaphylla**
Leaves smaller, 5–16(–20) × 3–9.5 cm. Inflorescences or infructescences cymose or spicate……………………………………………………………………12

12. Leaf apex long-acuminate………………………………………………**9. I. jacobsii**
Leaf apex acute, obtuse, mucronate, retuse or acuminate……………………………..13

13. Inflorescences or infructescences spicate…………………………………………14
Inflorescences or infructescences cymose……………………………………………15

14. Epiphyte. Leaves broadly oblong, apex acuminate; petiole *c.* 0.3 cm long. Fruits *c.* 4 mm diaeter…………………………………………………………………

I. ijuensis S.Andrews

(of Bt. Iju, Sarawak)

Sandakania 11 (1998) 4. Type: *Kudi S 23783*, Borneo, Sarawak, Bt. Iju (holotype SAR; isotypes A, BO, CGE, K, L, MEL, MOSC, SAN, SING).

Epiphyte. *Leaves alternate*, *coriaceous*, glossy and glabrous, *epunctate below*; *broadly oblong*, *14–15 × 4.5–7 cm*, base shortly attenuate, margin entire, *apex acuminate*; *petiole* glabrous, *c. 0.3 cm long*. Inflorescences unknown. *Infructescences* pubescent, *spicate*. *Fruits* (immature) ovoid, *c. 4 mm diameter*; pyrenes 4–5, deeply sulcate, glossy.

Endemic to Borneo; recorded only from Bt. Iju, Balingian in Sarawak (*S 23783*). Previously identified as *Ilex* sp. 9 in many herbaria.

Climber. Leaves elliptic-lanceolate, ovate or broadly oblong, apex obtuse; petiole 0.6–0.8 cm long. Fruits *c.* 2 mm diameter……………………………………………………..

I. stapfiana Loes.

(O. Stapf, 1857–1933, Austrian botanist, sometimes Keeper of the herbarium, Royal Botanic Gardens, Kew)

Monogr. Aquifol. 1 (1901) 431; Merrill, EB (1921) 353; Masamune *l.c.* 417; Anderson *l.c.* (1980) 151; Coode *et al.* (eds.) *l.c.* 30. Type: *Haviland & Hose 3357*, Borneo, Sarawak (holotype B†; isotypes K, L, SAR).

Glabrous *climber*. *Leaves alternate*, *coriaceous*, *epunctate below*; *elliptic-lanceolate*, *ovate* or *broadly oblong*, *7.5–16 × 3–6 cm*, base attenuate, margin entire, *apex obtuse* with acumen; *petiole 0.6–0.8 cm long*. *Inflorescences spicate*. Flowers yellow, 4-merous. *Fruits* ovoid, *c. 2 mm diameter*, dark red; pyrenes 8–11, smooth.

In hillsides and forest ridges on sandy clay soils. Endemic to Borneo and known from Sarawak (e.g., *Haviland 2279*, *Haviland 3357*, *S 13654*, *S 33549*, and *S 36837*), Brunei (e.g., *SAN 17390*) and Kalimantan (e.g., *Hallier 690*, *Shea 20648* and *Shea 26711*).

15. Leaf base cuneate. Inflorescences (primary peduncles) glabrous. Fruits 8.5–9.5 mm diameter……………………………………………………………**21. I. wallichii**
Leaf base attenuate or truncate. Inflorescences pubescent. Fruits 4.5–7 mm diameter….. ……………………………………………………………………………16

16. Twigs glabrous. Leaves 6–9 × 3–4.5 cm, apex shortly acute, rarely retuse; petiole glabrous, 0.5–0.8 cm long……………………………………………**1. I. beccariana**
Twigs pubescent. Leaves (9–)11.5–20 × (4–)5.5–9.5 cm, apex acute or acuminate; petiole pubescent, rarely glabrous, 0.7–1.2 cm long……………**11. I. macrophylla**

17. Leaves smaller, 1–6.5(–9.7) × 0.2–4.5 cm…………………………………………18
Leaves larger, 4–20(–22.5) × 2–10 cm…………………………………………………23

18. Leaf margin entire…………………………………………………………………19
Leaf margin undulate with a few spines or revolute with several small teeth or serrate on upper half only or crenate or serrate throughout…………..…………………………21

19. Leaves bullate, apex bluntly acuminate. Inflorescences or infructescences spicate..…….

I. fruticosa S.Andrews

(Latin, *fruticosus* = shrubby; the habit)

Sandakania 11 (1998) 4. Type: *Ilias S 26571*, Borneo, Sarawak, Bt. Salong, Ulu Samparau (holotype SAR; isotypes K, L).

Shrub to 2.5 m tall, occasionally epiphytic. *Leaves alternate*, *coriaceous*, glabrous above, glabrous and *punctate below*, *bullate*; elliptic-ovate, *3–4.2 × 1–1.6 cm*, base cuneate, *margin entire*, *apex bluntly acuminate*; *petiole* pubescent, *c. 0.2 cm long*. Inflorescences unknown. *Infructescences* pubescent, *spicate*. Fruits (immature) globose, *c.* 2.2 mm diameter, green; pyrenes 4, smooth.

Found in montane forest and on the edge of Kakus sandstone scarp. Endemic to Borneo; only recorded from Bt. Salong and Bt. Lumat in Sarawak (e.g., *S 21258* and *S 26571*). Previously identified as *Ilex* sp. 6 in many herbaria.

Leaves not bullate, apex emarginate or retuse. Inflorescences or infructescences racemose...……………………………………20

20. Leaves prominently punctate below, obovate to elliptic, smaller 1–3.5 × 0.2–2.5 cm, apex emarginate; petiole 0.1–0.6 cm long. Pyrenes 3–5, smooth…..**7. I. havilandii**
Leaves punctate on both surfaces, obovate or oblong-ovate, larger 3.5–6.5 × 2–4.5 cm, apex retuse; petiole *c.* 0.2 cm long. Pyrenes 6–8, sulcate to somewhat smooth…………
……………………………………………………………**17. I. orestes** (in part)

21. Leaf margin serrate in upper half only; petiole winged……………………

I. kinabaluensis S.Andrews

(of Mt. Kinabalu, Sabah)

Sandakania 11 (1998) 8; Beaman *et al. l.c.* 116. Type: *Andrews 890,* Borneo, Sabah, Mt. Kinabalu (holotype SNP; isotypes K, SAN). Synonym: *Ilex* sp. 1, Andrews, Sandakania 5 (1994) 49.

Shrub to 2.5 m tall. *Leaves alternate*, *coriaceous*, glabrous above, glabrous and *punctate below*; elliptic to obovate, *1.5–3 × 0.8–1 cm*, base cuneate, *margin serrate in upper half*, apex mucronate; *petiole* glabrous and *winged*, *0.4–0.5 cm long*. Inflorescences glabrous, males in fascicles, females in fascicles or solitary. Flowers white with pink or deep red on reverse of lobes, 4-merous. Fruits ovoid, *c.* 10 mm diameter, dark red to purple; pyrenes 4, striate.

Found in open montane *Leptospermum*-forest on sunny slopes on ultramafic soils. Endemic to Borneo and known only from Mt. Kinabalu area in Sabah (e.g., *Andrews 884*, *Clemens 32313* and *SAN 117233*).

Leaf margin undulate with a few spines or revolute with several small teeth or crenate or serrate throughout; petiole not winged……………………………………………..…….22

22. Leaf margin revolute with several small teeth; leaf apex mucronate. Shrub less than 5 m tall………………………………………………………………………………

I. revoluta Stapf

(Latin, *revolutus* = roll in; the leaf margin)

In W.J. Hooker, Icon. Plant. ser. 4 (1893) pl. 2263, FMK (1894) 139; Loesener *l.c.* 422; Gibbs, J. Linn. Soc. Bot. 42 (1914) 64; Masamume *l.c.* 416; Meijer, Bot. News Bull. Herb. For. Dept. 9 (1967) 90; Anderson *l.c.* (1980) 151; Andrews *l.c.* (1994) 46; Beaman *et al. l.c.* 117. Type: *Haviland 1087*, Borneo, Sabah, Mt. Kinabalu (holotype K).

Shrub less than 5 m tall. *Leaves alternate*, *coriaceous*, glabrous, *punctate below*; elliptic to obovate, *1.3–3 × 0.5–1.5 cm*, base cuneate, *margin revolute with several small teeth*, *apex mucronate*; *petiole* puberulous, *0.3–0.5 cm long*. Inflorescences puberulous. Male flowers in few-flowered cymes; female flowers solitary or in few-flowered cymes, white or pale pink, 4-merous. Fruits globose, 0.5–0.8 mm diameter, purplish black; pyrenes 3, minutely streaked.

In open montane *Leptospermum*-forest on shallow ultramafic soils. Endemic to Borneo, known only from Mt. Kinabalu area in Sabah (e.g., *Andrews 897*, *Clemens 50806*, *SAN 28559*, *SAN 29253*, and *SAN 82974*).

Leaf margin crenate or serrate throughout; leaf apex acute or acuminate. Shrub or small tree to 8 m tall, 10 cm diameter, occasionally epiphytic……..…………..**20. I. triflora**

23. Petiole channelled above. Inflorescences in axillary fascicles. Fruits 10–26 diamter……………………..………………………………24

Petiole not channelled above. Inflorescences or infructescences cymose or spicate. Fruits less than 10 mm diameter……………………………………………………………25

24. Twigs channelled when dried. Leaf base attenuate, margin undulate with a few spines, apex long-acuminate with rounded acumen……………………..**6. I. glomerata**

Twigs smooth when dried. Leaf base broadly cuneate, margin serrulate, apex acute or acuminate…………………………………………………………….…….**2. I. borneensis**

25. Leaf base rounded, rotundate, oblique, obtuse or acute………………………………26

Leaf base cuneate or broadly cuneate……………………………...………….…29

26. Leaves orbicular to elliptic, base oblique or obtuse, apex mucronate or sharply acute.…...

I. clethriflora S.Andrews

(Latin, *clethriflorus* = with flowers resembling those of *Clethra*, Clethraceae)

Sandakania 11 (1998) 3. Type: *Wood SAN A 4188*, Borneo, Sabah, Mt. Silam (holotype KEP; isotypes A, BO, K, L, SING).

Shrub to 4 m high. *Leaves alternate*, *thickly coriaceous*, glabrous above, glabrous and *punctate below*; *orbicular* to *elliptic*, *4–10.5 × 3–6.6 cm*, *base oblique* or *obtuse*, *margin entire*, *apex mucronate* or *sharply acute*; *petiole not channelled above*, glabrous, *0.2–0.4*(*–1*) *cm long*. *Inflorescences* pubescent, *spicate*. Flowers white, 4–5-merous. *Fruits* (immature) globose, *c. 3 mm diameter*; pyrenes 4(–5), sulcate.

Found in montane forest on ultramafic ridges. Endemic to Borneo; only recorded from Bt. Silam in Sabah (*SAN A 4188*). Previously identified as *Ilex* sp. 3 in many herbaria.

Leaves of other shapes, base rounded or acute or rotundate………....……………27

27. Leaf base rotundate, apex long-acuminate................................**19. I. spicata**
Leaf base rounded or acute, apex acute or acuminate.....................................28

28. Leaf margin revolute. Fruits barrel-shaped, 3–3.5 mm diameter; pyrenes 16–23, marked with fine irregular streaks. Tree or shrub to 37 m tall, 60 cm diameter, or occasionally epiphytic climber.......................................**12. I. malaccensis**
Leaf margin not revolute. Fruits globose, 7–9 mm diameter; pyrenes 4–5, densely villous, matted glutinous. Epiphytic shrub or climber..

I. clemensiae Heine

(M.S. Clemens, 1873–1968, wife of J. Clemens, plant collector)

Bot. Munchen 6 (1953) 208; Andrews *l.c.* (1994) 42; Coode *et al.* (eds.) *l.c.* 30; Beaman *et al. l.c.* 115. Syntypes: *Clemens 31218* (BM, BO, K, L, M), *Clemens 32083* (A, BM, G, K, L, M), and *Clemens 50259* (G, K, L, M), Borneo, Sabah, Mt. Kinabalu.

Epiphytic shrub or *climber*. *Leaves alternate*, *coriaceous*, glabrous above, glabrous and *punctate below*; *ovate-oblong*, or *elliptic* to *broadly elliptic*, *7.5–10.5 × 3.5–5(–6.5) cm*, *base rounded*, *margin entire*, *not revolute*, *apex acuminate*; *petiole not channelled above*, glabrous or puberulous, *3–5 mm long*. *Inflorescences* pubescent, *spicate*. Flowers creamy white, 4–5-merous. *Fruits globose*, *7–9 mm diameter*, dark purple; *pyrenes 4–5*, *densely villous*, *matted glutinous*.

On montane ridges. Endemic to Borneo; recorded from Penibukan, Mt. Trus Madi FR and Mt. Lotung in Sabah (e.g., *Clemens 32083*, *Clemens 31218*, *Clemens 40607*, and *Clemens 50259*), and from several locations in Sarawak (e.g., *S 25721*, *S 30847*, *S 33012*, and *S 52534*). Also found in Brunei (e.g., *Coode 7547* and *Dransfield JD 7203*).

29. Leaf apex acute or acuminate..30
Leaf apex retuse, obtuse or mucronate...33

30. Petiole 0.3–1 cm long. Inflorescences or infructescences spicate...................31
Petiole 1–2 cm long. Inflorescences or infructescences cymose......................32

31. Climbers. Petiole 0.3–0.4 cm long. Pyrenes 8–11.......................................

I. poiensis S.Andrews

(of G. Poi, Sarawak)

Sandakania 11 (1998) 10. Type: *Clemens 22582*, Borneo, Sarawak, G. Poi (holotype SAR; isotypes BO, K).

Glabrous *climber*. *Leaves alternate*, *coriaceous*, *punctate below*; broadly oblong, elliptic or broadly elliptic, *8.5–11 × 4–6 cm*, *base broadly cuneate*, *margin entire*, *apex acute*; *petiole not channelled above*, *0.3–0.4 cm long*. Inflorescences unknown. *Infructescences spicate*. *Fruits* (unripe) globose, *4–5 mm diameter*, yellowish green; *pyrenes 8–11*, centrally sulcate.

In primary forest, near summits on tertiary granodiorite. Endemic to Borneo; so far only recorded from G. Gading and G. Poi in Sarawak (e.g., *Chew CWL 584*, *Clemens 20365*, *Clemens 22582*, and *S 18467*). Previously identified as *Ilex* sp. 17 in many herbaria.

Shrubs. Petiole *c.* 1 cm long. Pyrenes 6...

I. sarawaccensis Loes.

(of Sarawak)

Monogr. Aquifol. 1 (1901) 434; Merrill *l.c.* (1921) 353; Masamune *l.c.* 416. Type: *Beccari PB 2122*, Borneo, Sarawak, Santubong (holotype FI).

Shrub. *Leaves alternate*, *coriaceous*, glabrous, *punctate below*; oblong to broadly oblong or broadly elliptic, *10–13.5 × 4.5–7.5 cm*, *base cuneate*, *margin entire*, *apex acuminate* or *acute*; *petiole* glabrous, *not channelled above*, *c. 1 cm long*. Inflorescences unknown. *Infructescences* glabrous, *spicate*. *Fruits* globose, *c. 4.5 mm diameter*, red; *pyrenes 6*, centrally sulcate.

Endemic to Borneo and only known from Mt. Santubong in Sarawak.

32. Twigs pubescent (when young), black when dried. Leaves glaucous below. Pyrenes 8–10, sulcate……………………………………………………………**8. I. hypoglauca**
Twigs glabrous, greyish to brownish when dried. Leaves not glaucous below. Pyrenes 4, striate……………………………………………………………**15. I. nervulosa**

33. Petiole 0.3–0.8 cm long……………………………………………………………34
Petiole 1–3 cm long……………………………………………………………35

34. Leaves glossy above, prominently punctate below; margin entire or undulate with a few minute spines. Inflorescences cymose. Tree to 7 m tall…………………**10. I. kelabitana**
Leaves dull above, faintly punctate below; margin entire and revolute. Inflorescences or infructescences in lax compound cymes. Shrub or treelet less than 5 m tall……………..

I. keranjiensis S.Andrews

(of Tg. Keranji, Sarawak)

Sandakania 11 (1998) 7. Type: *Anderson S 19123*, Borneo, Sarawak, Tg. Keranji (holotype SAR; isotypes K, L, SAN, SING).

Treelet less than 5 m tall. *Leaves alternate*, *coriaceous*, glabrous and *dull above*, *faintly punctate* and paler *below*; obovate, elliptic or obovate-oblong, *5.5–12 × 2–5 cm*, *base cuneate*, *margin entire and revolute*, *apex obtuse and retuse*; *petiole* puberulent, *not channelled above*, *0.3–0.8 cm long*. Inflorescences unknown. *Infructescences* puberulous, *in lax compound cymes*. Fruits (unripe) narrowly ovoid and ribbed, green.

Occurring in *alan bunga* forest type of peat swamp forest. Endemic to Borneo (Sarawak, Tg. Keranji; e.g., *S 14216*, *S 19123* and *S 26693*). Previously identified as *Ilex* sp. 16 *p.p.* in many herbaria.

35. Leaves oblong, obovate-oblong, or broadly obovate-oblong, base cuneate, apex mucronate or retuse (rarely obtuse). Inflorescences glabrous (only rarely puberulous), in compound cymes. Fruits 5–9 mm diameter. Tree to 25 m tall…….**18. I. promecophylla**
Leaves ovate, broadly ovate, or oblong-ovate, base broadly cuneate, apex obtuse. Inflorescences puberulous, cymose. Fruits 3–3.5 mm diameter. Shrub less than 5 m tall……………………………………………………………………………

I. renae S.Andrews

(Rena George, 1955–1994, former officer-in-charge of the Semengoh Botanical Research Centre, Sarawak)

Sandakania 11 (1998) 12. Type: *Haviland & Hose 2011*, Borneo, Sarawak, Bt. Lambir (holotype BO; isotypes BM, L).

Shrub or *small treelet less than 5 m tall*. *Leaves alternate*, *coriaceous*, glabrous and glossy above, glabrous and *slightly punctate below*; *ovate*, *broadly ovate* or *oblong-ovate*, *6–12.5 × 4–6.5(–9.5) cm*, *base broadly cuneate*, *margin entire*, *apex obtuse*; *petiole* glabrous, *not channelled above*, *1–2.5 cm long*. *Inflorescences puberulous*, *cymose*. Male flowers 4(–5)-merous. Female flowers unknown. *Fruits* (unripe) globose, *3–3.5 mm in diameter*, green; pyrenes 5, sulcate.

On summits of hills in *kerangas* forest on Kakus sandstone. Endemic to Borneo. In Sarawak, recorded only from the Lambir Hills NP (e.g., *S 3022*, *S 21229*, *S 38354*, *S 40406*, and *S 43111*). Previously identified as *Ilex* sp. 18 in many herbaria.

1. **Ilex beccariana** Loes.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Monogr. Aquifol. 1 (1901) 96; Merrill *l.c.* (1921) 352; Masamune *l.c.* 414; Andrews *l.c.* (1998) 17. **Lectotype** (Andrews, 1998)**:** *Beccari PB 1482*, Borneo, Sarawak, Mt. Matang (hololectotype FI; isolectotypes BO, K).

Shrub or tree. **Twigs** somewhat thickened, knobbly, *glabrous*, lenticellate and exfoliating. **Leaves** *alternate*, *subcoriaceous* to *coriaceous*, glabrous, drying blackish above, greyish with a bloom and *epunctate below*; obovate or elliptic or ovate, *6–9 × 3–4.5 cm*, *base attenuate*, margin entire, *apex shortly acute*, *rarely retuse*; midrib glabrous, sunken above, prominent below; lateral veins 7–12 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole glabrous*, *0.5–0.8 cm long*. **Inflorescences** *pubescent*, *cymose*. **Flowers:** males 4–5-merous; females unknown. **Fruits** (immature) globose, *6–7 mm diameter*, smooth; stalk pubescent, *c.* 5 mm long; pyrenes 7–8.

Distribution. Endemic to Borneo; recorded only from Mt. Matang, Sarawak (*Beccari PB 1482*, *Beccari PB 1879* and *Beccari PB 2056*).

2. **Ilex borneensis** Loes.

(of Borneo)

Monogr. Aquifol. 1 (1901) 248; Merrill *l.c.* (1921) 352; Masamune *l.c.* 415; Andrews *l.c.* (1998) 21. **Lectotype** (Andrews, 1998)**:** *Beccari PB 1652*, Borneo, Sarawak, Mt. Matang (hololectotype FI). **Synonym:** *Diospyros sororia* Bakh., Bull. Jard. Bot. Buitenz. 15, 2 (1937) 125.

Tree to 18 m tall; bole fluted at base; without buttresses. **Bark** smooth, thin, grey or light brown, somewhat powdery or flaked; inner bark greenish. **Sapwood** yellowish. **Twigs** slender, *smooth when dried*, glabrous. **Leaves** *alternate*, *coriaceous*, drying brownish, glabrous, *slightly punctate below*; oblong-elliptic to broadly elliptic, or ovate-oblong, or narrowly obovate to broadly obovate, (*9.5–*)*12–20.5*(*–22.5*) × *4–7.5*(*–9*) *cm*, *base broadly cuneate*, *margin serrulate*, *apex acute* or *acuminate*; midrib glabrous, sunken above, prominent below; lateral veins 6–12 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subprominent above, prominent below; intercostal venation broadly reticulate, subprominent to obscure above, prominent below; *petiole* glabrous, *deeply channelled above when dried*, *1–2*(*–3.2*) *cm long*. **Inflorescences** glabrous, *in axillary fascicles*. **Flowers** 4–5-merous, greenish white. **Fruits** (immature) globose to oblong, *20–26* *mm diameter*, green to orange; stalk glabrous, *c.* 5 mm long; pyrenes 4, open rugose.

Distribution. Endemic to Borneo. In Sarawak, recorded from Semengoh FR, Mt. Matang, Mt. Penrissen, Bt. Alak, Serian, Bt. Senyandang, and Sg. Pesu (e.g., *Jacobs 5103*, *S 16647*, *S 37172*, *S 44023*, and *S 48909*). Also known from Kalimantan (e.g., *Burley et al. 2475*, *Hallier 3077* and *Shea 26880*).

Ecology. In primary lowland and hill mixed dipterocarp forests, rarely in secondary forest, at altitudes to 1000 m.

Notes. *Ilex borneensis* has unusually large fruits for the genus and thus has been confused with several other taxa. These include *Salacia castaneifolia* Ridl. (Celastraceae), *Matthaea sancta* Blume (Monimiaceae), *Erycibe* spp. (Convolvulaceae), *Symplocos* spp. (Symplocaceae), Flacourtiaceae, Euphorbiaceae, and Ebenaceae.

3. **Ilex celebensis** Capit.
(of Celebes)

Bull. Soc. Bot. Fr. 57 (1910) 236; Beaman *et al. l.c.* 114. **Type:** *Teijsmann 13707*, Sulawesi (holotype BO; isotype K).

Distribution. Sumatra, Borneo, Sulawesi, Maluku, and the Lesser Sunda Islands.

var. **ranauana** S.Andrews
(of Ranau, Sabah)

Sandakania 11 (1998) 2. **Type:** *Clemens 29245*, Borneo, Sabah, Mt. Kinabalu, Kundasang (holotype SING; isotypes BM, BO, G, K, L, NY). **Synonym:** *Ilex* sp. *aff. wightiana auct. non* Wall. *ex* Wight: Andrews *l.c.* (1994) 49.

Tree to 18 m tall. **Bark** smooth, dark greenish; inner bark white. **Sapwood** hard, yellowish or sandy coloured. **Twigs** *glabrous*, new growth shortly pubescent. **Leaves** *alternate*, *subchartaceous*, glabrous on both surfaces, *not glaucous and slightly punctate below*; *elliptic* or *lanceolate*, *6–9.2 × 2–3.4 cm*, *base acute*, margin entire, *apex caudate and obtuse*; midrib glabrous and sunken above, prominent with scattered hairs below; lateral veins 6–9 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure to subprominent on both surfaces; intercostal venation broadly reticulate, obscure on both surfaces; *petiole puberulous*, *0.5–0.8 cm long*. **Inflorescences** *in fascicles* or *few-flowered cymes*, *hispid* or *pubescent*. **Flowers** 5–6-merous, white. **Fruits** globose, *4–4.5 mm diameter*, *not ribbed*, brownish red, hispid when young; pericarp chartaceous; stalk pubescent, 7–8 mm long; *pyrenes 5–7*, *shallowly sulcate*.

Distribution. Sumatra and Borneo. In Borneo, recorded from Sosopodon, Kundasang and Tenompok in Sabah (e.g., *Clemens 28808*, *SAN 42466*, *SAN 42476*, *SAN 46711*, and *SAN 60625*).

Ecology. In primary lower montane forest, at about 1500 m altitude.

Notes. The other variety, var. *celebensis*, occurs in Sulawesi, Maluku and the Lesser Sunda Islands.

4. **Ilex cissoidea** Loes.

(Greek, *cissoideus* = resembling *Cissus*, Vitaceae)

Monogr. Aquifol. 1 (1901) 430; Merrill *l.c.* (1921) 352; Airy Shaw *l.c.* (1939) 511; Masamune *l.c.* 415; Meijer *l.c.* 90; Anderson *l.c.* (1980) 150; Andrews *l.c.* (1994) 42; Coode *et al.* (eds.) *l.c.* 30; Argent *et al.* (eds.) *l.c.* 85. **Type:** *Beccari PB 3144*, Borneo, Sarawak, Batang Lupar (holotype FI; isotype K). **Synonym:** *Octas spicata auct. non* Blume: Jack, Malay. Misc. 2, 7 (1822) 64, Merrill, J. Arn. Arb. 33 (1952) 238, Airy Shaw, Kew Bull. 16 (1962) 84.

Tree to 38 m tall; buttresses rarely noted. **Bark** smooth, thin, grey or greenish white or dark brownish with some mottling; inner bark variable in colour, often with yellow sclerotic masses. **Sapwood** watery, pale yellow to brown or pale orange. **Twigs** slender, *pubescent*, channelled and black when dried. **Leaves** *alternate*, *chartaceous* to *subchartaceous*, drying blackish, usually glabrous above, *punctate and not glaucous below*; *ovate-elliptic* to *ovate-oblong*, *7–15 × 3–5 cm*, *base rounded* or *cordate*, margin entire, *apex acuminate* or shortly so; midrib pubescent and deeply sunken above, sparsely pubescent and prominent below; lateral veins 8–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole pubescent*, channelled above, *0.8–1.3 cm long*. **Inflorescences** densely pubescent, *spicate*. **Flowers** white or greenish white, (4–)5(–6)-merous. **Fruits** globose, *2–2.5 mm diameter*, *not ribbed*, reddish black; stalk densely pubescent, 1–1.5 mm long; *pyrenes 5–8*, *striate*.

Vernacular names. Sabah—*loboh* (Malay), *lundudon payon* (Kadazan), *magis agis*, *magisugis* (Dusun, Ranau), *marogis*, *morogis* (Dusun, Kundasang and Bundu Tuhan), *morogis sawa* (Dusun). Sarawak—*aras* (Iban), *geredam pangi* (Dulit area), *kemuding* (Punan), *langidan*, *lengidan* (Kelabit).

Distribution. Sumatra, Borneo and Sulawesi. In Sabah and Sarawak, common and widespread (e.g., *Andrews 1577*, *SAN 32297*, *SAN 58429*, *S 33388*, and *S 42051*). Also known from Brunei (e.g., *Dransfield JD 7495* and *Sands 5711*) and Kalimantan (e.g., *Argent et al. 93116*, *Endert 1732* and *Shea 26054*).

Ecology. Locally common, found in primary and secondary forests, along shady ridges or streams, at altitudes to 1850 m.

Uses. The wood is mainly used for firewood, but suggestions have been made that it is also suitable for making matches and for construction. Dry leaves are pounded and stored in bamboo internodes and the powder is used as bathing soap. In former days, the Kelabit people dried the yeast for alcohol brewing in the smoke from *I. cissoidea*, as it has no smell.

Notes. Malformed sepals and petals are a common feature.

5. **Ilex cymosa** Blume

(Latin, *cyma* = cyme; referring to the cymose inflorescences)

Bijdr. Fl. Ned. Ind. (1827) 1149; Hooker *f. l.c.* 605; King *l.c.* 136; Loesener *l.c.* 74; Merrill *l.c.* (1921) 352; Ridley *l.c.* (1922) 442; Masamune *l.c.* 415; Browne *l.c.* 200; Meijer *l.c.* 91; Anderson *l.c.* (1972) 25, *l.c.* (1980) 150; Corner *l.c.* 163; Keng *l.c.* 114; Turner, Gard. Bull. Sing. 45 (1993) 37; Kessler & Sidiyasa, TBSA-EK (1994) 54; Andrews *l.c.* (1994) 43; Turner *l.c.* (1995) 131; Coode *et al.* (eds.) *l.c.* 30; Argent *et al.* (ed.) *l.c.* 85; Andrews *l.c.* (1998) 22; Beaman *et al. l.c.* 115. **Lectotype** (Andrews, 1998)**:** *Blume s.n.* (= *RHL Sheet No. 90413497*), Java (hololectotype L). **Synonyms:** *Prinos cymosa* (Blume) Hassk., Tijdschr. Nat. Gesch. & Phys. 10 (1843) 140; *I. philippinensis* Rolfe, J. Linn. Soc. Bot. 21 (1884) 308; *I. cumingiana* Rolfe *l.c.* 308; *I. cymosa* var. *cumingiana* (Rolfe) Loes. *l.c.* 76.

Tree to 30 m tall, rarely with small buttresses. **Bark** thin, smooth or slightly rough, occasionally lenticellate or hooped, grey or greyish brown, pale brown or white, somewhat spotted; inner bark variable in colour, often yellowish to orange, or brown, or with a tinge of green, coarse (gritty) and fibrous. **Sapwood** white to greyish white or yellow, watery. **Twigs** glabrous, green when young, grey or white, somewhat spotted with prominent lenticels, peeling. **Leaves** *alternate*, *chartaceous*, glabrous and glossy above, glabrous, *epunctate* and *somewhat glaucous below*; elliptic to broadly elliptic, or obovate, narrowly oblong to oblong-ovate or lanceolate, 5.3–14 × 2.3–5.7 cm, *base obtuse*, margin entire, apex obtusely acuminate or obtuse; midrib glabrous, sunken above, prominent below; lateral veins 6–12 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, sunken and subprominent above, prominent to subprominent below; intercostal venation broadly reticulate, subprominent on both surfaces; *petiole glabrous*, *0.5–1.3 cm long*. **Inflorescences** puberulous, *in lax compound cymes*; bracts glabrous, acute or acuminate, subpersistent. **Flowers** olive-green, greenish white or white, slightly fragrant; males 4–5-merous; females 10–12-merous. **Fruits** globose, 3–3.5 (–4) mm diameter, red ripening black, *always ribbed when dried*; pericarp chartaceous; stalk pubescent, 5–6 mm long; *pyrenes 8–10*, *deeply sulcate*, almost glossy.

Vernacular names. Sabah—*bangkulat* (Kadazan), *bangkulatan*, *bengkulatan* (Malay), *belimbing hutan* (Tidong), *bingkolat* (Dusun), *mangkulat*, *mogkulat* (Kadazan), *mer pinggau* (Dusun, Kinabatangan), *sidapong* (Tidong), *tampulan* (Dusun, Kinabatangan). Sarawak—*bengkulat* (Iban), *kerdam ayer* (preferred name), *perdoh* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku. In Sabah and Sarawak, common (e.g., *Clemens 9706*, *Elmer 20841*, *SAN 34563*, *SAN 68039*, *SAN 123445*; *S 9789*, *S 25114*, *S 37421*, and *S 48678*). Also known from Brunei (e.g., *Coode 7654*, *S 7854* and *Simpson 2576*) and Kalimantan (e.g., *Ambriansyah & Arifin W 968*, *Kostermans 21685* and *Sidiyasa & Arifin 1071*).

Ecology. Locally common in coastal padang vegetation on white sandy soils, peat swamp, riverine and mangrove forests, and in mixed dipterocarp forests on hilltops or slopes, at altitudes to 750(–1200) m.

Uses. The timber is used for firewood. The root is said to have medicinal properties and is mainly used in the treatment of fever, while the leaves are used for sprains.

Notes. A common, widespread and morphologically variable species, *Ilex cymosa* is often misidentified as *Chionanthus laxiflorus* Blume, *C. ramiflorus* Roxb. (Oleaceae), *Syzygium* Gaertn. (Myrtaceae), *Maesa* Forssk. (Myrsinaceae), or *Xanthophyllum* Roxb. (Polygalaceae). A form with pubescent twigs, petioles and calyces is found sporadically throughout the range (13 collections seen).

6. **Ilex glomerata** King

(Latin, *glomeratus* = collected closely together into a head; referring to the flowers).

J. As. Soc. Beng. 64, 2 (1895) 135; Loesener *l.c.* 325; Ridley *l.c.* (1922) 439; Kiew, TFM 3 (1978) 5; Andrews *l.c.* (1994) 43; Turner *l.c.* (1995) 131; Coode *et al.* (eds.) *l.c.* 30; Andrews *l.c.* (1998) 25; Beaman *et al. l.c.* 115. **Lectotype** (Andrews, 1998)**:** *King's Collector 6926*, Peninsular Malaysia, Perak, Larut (hololectotype CAL; isolectotypes BO, CAL, K, SING). **Synonym:** *Ilex cf. triflora auct. non* Blume: Meijer *l.c.* 90.

Shrub or tree to 20 m tall; often with low rounded buttresses. **Bark** dark, smooth; inner bark thin, variable in colour, often pale green to greenish yellow or somewhat brown. **Sapwood** pale yellow or orange to whitish brown. **Twigs** glabrous, *channelled when dried*. **Leaves** *alternate*, *subcoriaceous*, glabrous, slightly *punctate below*; elliptic to oblong-elliptic, *6.5–12.5*(*–13.5*) *× 2–5 cm*, *base attenuate*, *margin undulate with few minute spines*, *apex long-acuminate with rounded acumen*; midrib glabrous, deeply sunken above, prominent below; lateral veins 6–7 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure above, obscure to subprominent below; *petiole* glabrous, *channelled above*, *1–2 cm long*. **Inflorescences** pubescent, *in axillary fascicles*. **Flowers** 4-merous, yellow green or yellow. **Fruits** globose, *c. 10 mm diameter*, red; pericarp thick, wrinkled when dried; stalk pubescent, 7–10 mm long; pyrenes 4, rugose.

Distribution. Burma, Sumatra, Peninsular Malaysia, and Borneo. In Sarawak, found in Bt. Salong and Bt. Taji Buloh (e.g., *S 14394* and *S 25842*). In Sabah, known from Mt. Kinabalu and surrounding areas and Mt. Lotung (e.g., *Clemens 28843*, *RSNB 4983*, *SAN 25328*, *SAN 76473*, and *SAN 124490*). Known also from Brunei (e.g., *S 0941*, *S 12357* and *Wong WKM 822*).

Ecology. In primary and secondary hill and lower montane forests, on slopes and ridges, at altitudes to 1700 m.

Notes. Fruiting specimens may be confused with species of *Drypetes* Vahl. (Euphorbiaceae).

7. **Ilex havilandii** Loes.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Monogr. Aquifol. 1 (1901) 423; Merrill *l.c.* (1921) 352; Masamune *l.c.* 415; Meijer *l.c.* 90; Anderson *l.c.* (1980) 150; Andrews *l.c.* (1994) 44; Coode *et al.* (eds.) *l.c.* 30; Beaman & Anderson, Contrib. Univ. Mich. Herb. 21 (1997) 112; Andrews *l.c.* (1998) 27; Beaman *et al. l.c.* 116. **Lectotype** (Andrews, 1998)**:** *Haviland 1114*, Borneo, Sabah, Mt. Kinabalu (hololectotype K; isolectotypes SAR, SING). **Synonyms:** *I. vacciniifolia auct. non* Klotzsch *ex* Reiss: Stapf *l.c.* 140, Masamune *l.c.* 415; *I. vacciniifolia* var. *camptoneura* Stapf *l.c.* 140, Masamune *l.c.* 415; *I. vacciniifolia* var. *subenervis* Stapf *l.c.* 140, Masamune *l.c.* 415; *I. havilandii* Loes. var. *camptoneura* (Stapf) Loes. *l.c.* 423; *I. havilandii* Loes. var. *subenervis* (Stapf) Loes. *l.c.* 423; *I. confertifolia* Merr., Sarawak Mus. J. 3 (1928) 526; *I. orestes* Ridl. var. *dulitensis* Airy Shaw *l.c.* (1939) 510, Masamune *l.c.* 416.

Stiffly erect shrub, sometimes epiphytic, often multistemmed tree to 14 m tall. **Bark** not smooth, grey to white; inner bark often brownish or yellowish green, with a sticky sap. **Sapwood** pale yellow to pale brown. **Twigs** *short-puberulous*, channelled when dried. **Leaves** *alternate*, *coriaceous*, glabrous above, glabrous or sparsely puberulous and *prominently punctate below*; *obovate* to *elliptic*, *1–3.5 × 0.2–2.5 cm*, base cuneate, *margin entire* often revolute, *apex emarginate*; midrib glabrous and sunken above, glabrous or sparsely puberulous and prominent to subprominent below; lateral veins 3–6 pairs, alternate, ascending, obscure above, subprominent below; intercostal venation obscure on both surfaces; *petiole* glabrous or puberulous, *0.1–0.6 cm long*. **Inflorescences** puberulous, *in axillary racemes*. **Flowers** white or pink to purple-tinged on outer lobes, 3–5-merous. **Fruits** globose, 2–3.5 mm diameter, purplish black or reddish, closely wrinkled when dried; stalk puberulous, 2–7 mm long; *pyrenes 3–5*, *smooth*.

Vernacular names. Sarawak—*temi* (Kenyah), *temiang* (Iban).

Distribution. Endemic to Borneo. In Sabah, recorded from Mt. Kinabalu, Mt. Tambulanan, Mt. Alab, Mt. Trus Madi, Mt. Meliau, and Mt. Taviu (e.g., *Andrews 899*, *Clemens 32330*, *SAN 41870*, *SAN 81781*, and *SAN 83000*). In Sarawak, found on Mt. Murud NP, Mt. Mulu NP, Bt. Lawi, Mt. Dulit, Merurong plateau, Ulu Sg. Tutoh, Bt. Batanga, Mt. Munro, Mt. Kalulon, Tama Abu Range, and Bt. Pagon Kecil (e.g., *Richards 1886*, *S 33041*, *S 38754*, *S 50860*, and *S 51144*). Also occurs in Brunei (e.g., *Coode 7462*) and Kalimantan (e.g., *Kato et al. 11055*).

Ecology. Locally common. Found on ridges in hill to montane forests, at altitudes to 3500 m.

Notes. An extremely variable species in its leaf morphology. Not to be confused when sterile with *Vaccinium stapfianum* Sleumer (Ericaceae), which has dash-shaped glands on the lower leaf surface, as opposed to the circular glands of *I. havilandii*.

8. **Ilex hypoglauca** (Miq.) Loes. Fig. 1.

(Latin, *hypoglaucus* = glaucous beneath; referring to the lower leaf surface)

Monogr. Aquifol. 1 (1901) 80; Anderson *l.c.* (1972) 25, *l.c.* (1980) 150. **Basionym:** *Prinos hypoglauca* Miq., Fl. Ned. Ind. Suppl. 1 (1860) 201, 514. **Type:** *Horsfield 21*, Sumatra, Bangka (holotype K; isotypes BM, L).

Tree to 18 m tall. **Bark** smooth and grey, with numerous white corky lenticels; inner bark hard and brittle, pale grey and white, mottled with orange brown fibres. **Sapwood** white, darkening to pale yellow. **Twigs** *pubescent* when young, later *glabrous*, *black when dried*. **Leaves** *alternate*, *thickly coriaceous*, glabrous, *glaucous* and *punctate below*; elliptic or oblong to broadly oblong, *9–22.5 × 5–10 cm*, *base cuneate*, *margin entire*, *apex acuminate*; midrib covered with scattered hairs, sunken above, prominent below; lateral veins 6–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping, becoming more obscure before leaf margin, sunken and prominent on both surfaces; intercostal venation broadly reticulate, sunken and

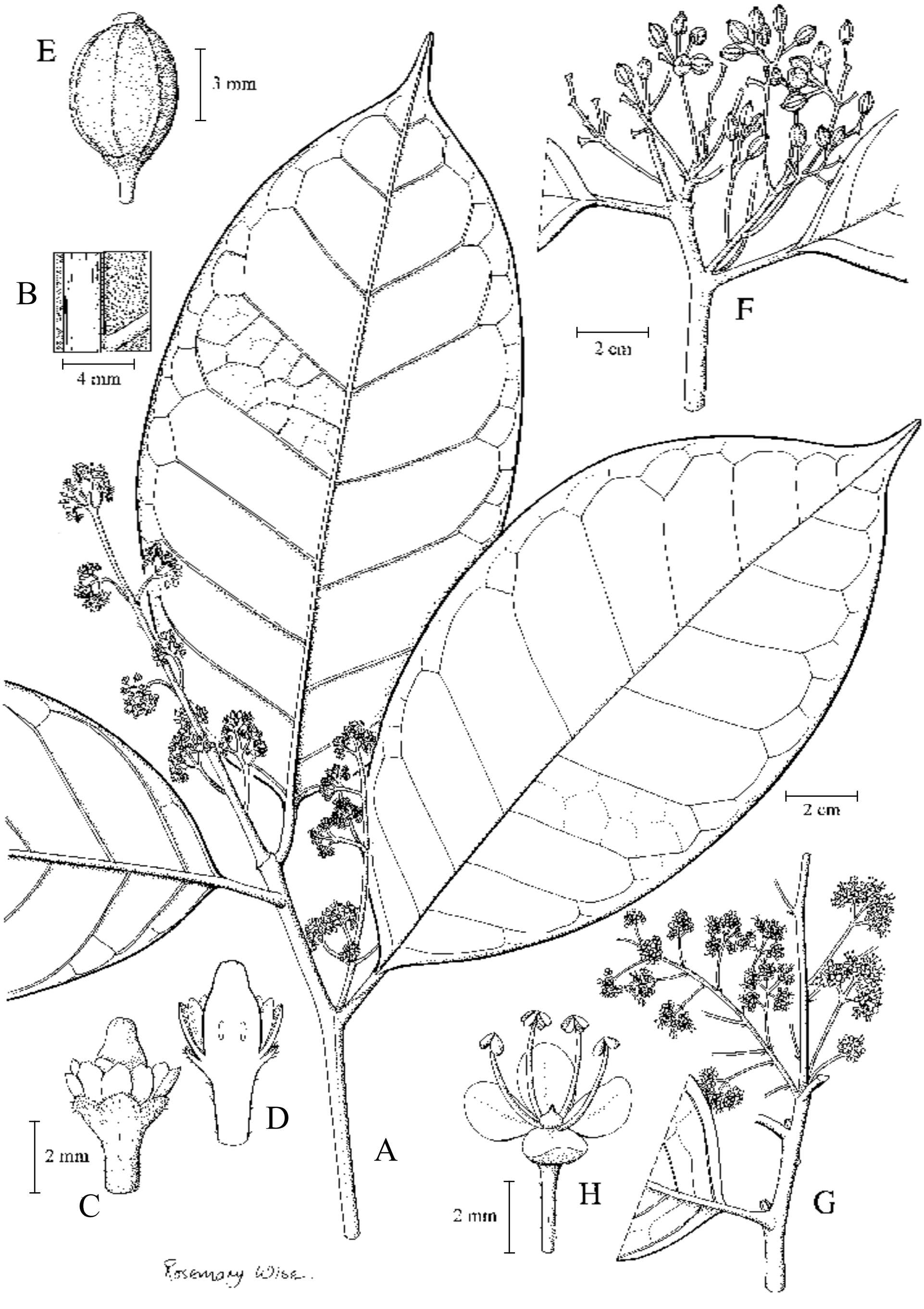


Fig. 1. *Ilex hypoglauca*. A, flowering (female) leafy twig; B, detail of lower leaf surface; C, female flower; D, longitudinal section through female flower; E, fruit; F, part of infructescence; G, part of male inflorescences; H, male flower. (A–D from *S 30575*, E–F from *Hallier 2875*, G–H from *Haviland & Hose 3744*.)

subprominent above, prominent below; *petiole* puberulous or glabrous, somewhat stout, *not channelled above*, *1–2 cm long*. **Inflorescences** pubescent, *in axillary*, *long compound cymes*. **Flowers** white; males 4–5-merous; females 16-merous. **Fruits** ovoid or globose, *3–4 mm diameter*, black, strongly ribbed (when mature); stalk pubescent, *c.* 6 mm long; *pyrenes 8–10*, *sulcate*.

Vernacular names. Sarawak—*kerdam mungkulat* (preferred name), *lengebah* (Milanau, Matu), *mungkulat* (Milanau, Matu).

Distribution. Sumatra and Borneo. In Sarawak, known from a few localities in Baram, Kuching and Sibu districts (e.g., *Haviland 2872*, *S 3153*, *S 3271*, and *S 8536*). Also known from Brunei (e.g., *Simpson 2276* and *Wong WKM 1040*) and Kalimantan (e.g., *bb. 35977*, *Hallier 2875* and *Kostermans 12957*).

Ecology. Found in primary peat swamp forest, at low altitudes.

Uses. The wood could be useful in the dowel and moulding industry and for the manufacture of small articles (Anderson *l.c.* (1972) 25).

9. **Ilex jacobsii** S.Andrews

(M. Jacobs, 1929–1983, former botanist at the Rijksherbarium, Leiden)

Sandakania 11 (1998) 5. **Type:** *Jacobs 5057*, Borneo, Sarawak, Mt. Penrissen (holotype SAR; isotypes B, G, K, L, US). **Synonym:** *Ilex* sp. 8, Coode *et al.* (eds.) *l.c.* 31.

Small tree to 7 m, or epiphytic climber. **Leaves** *alternate*, *subcoriaceous*, glabrous, drying dull brown and *epunctate below*; elliptic-oblong to broadly elliptic-oblong, *9–16.5 × 3.5–7 cm*, base shortly attenuate, margin entire, *apex long-acuminate*; *petiole* glabrous, *0.4–0.7 cm long*. **Inflorescences** glabrous, *spicate*. **Flowers:** females greenish white to white, 5–6-merous; males unknown. **Fruits** globose, ellipsoid when young, *c.* 5 mm diameter, glossy red; pyrenes 5–6, smooth, glossy, tear-like.

Distribution. Endemic to Borneo; recorded from several localities in Sarawak (e.g., *Jacobs 5057*, *S 21159*, *S 25824*, *S 36523*, and *S 43164*). Also found in Brunei (e.g., *Coode & Wong 6500* and *Coode & Wong 6574*).

Ecology. Found in lowland mixed dipterocarp forest on shale in river valley, sandstone substrate and basalt hillside.

10. **Ilex kelabitana** S.Andrews

(of Kelabit Highlands, Sarawak)

Sandakania 11 (1998) 6. **Type:** *Awa et al. S 50466*, Borneo, Sarawak (holotype SAR; isotypes K, KEP, L, MO, SAN).

Tree to 7 m tall. **Twigs** slightly puberulous, brownish. **Leaves** *alternate*, *coriaceous* and brittle, glabrous and *glossy above*, glabrous and *prominently punctate below*; broadly elliptic or broadly oblong, *9–14.5 × 5–9 cm*, *base broadly cuneate*, *margin entire* or *undulate with a few minute spines*, *apex retuse*; midrib glabrous, deeply sunken above, prominent below; lateral veins 7–10 pairs, subopposite to alternate, widely spaced, ascending and obscure before leaf margin, subprominent above, prominent below; intercostal venation obscure above, subprominent below; *petiole* glabrous, *not channelled above*, *0.4–0.7 cm long*. **Inflorescences** pubescent, *cymose*. **Flowers:** males white, 5-merous; females unknown. **Fruits** (immature) ellipsoid, pale green to red; stalk pubescent, *c.* 2.5 mm long; pyrenes 5–6, sulcate.

Vernacular names. Sarawak—*bupok* (Kelabit). Kalimantan—*bupuk* (Dayak).

Distribution. Endemic to Borneo. Recorded from the Kelabit Highlands and Bt. Pagon Kecil in Sarawak (e.g., *Nooteboom & Chai 02172*, *S 35361*, *S 47737*, and *S 50466*). Also occur in Kalimantan (e.g., *Geesink 8946* and *Kato et al. 8469*).

Ecology. In *kerangas* forest, at altitudes to 1300 m.

Notes. This taxon was previously identified as *Ilex* sp. 20 in many herbaria.

11. **Ilex macrophylla** Wall. *ex* Hook.*f.*

(Greek, *makro* = long, *phullon* = leaf; long-leaved)

Fl. Brit. Ind. 1 (1875) 604; King *l.c.* 136; Loesener *l.c.* 84; Ridley *l.c.* (1922) 442; Kiew, TFM 3 (1978) 8; Anderson *l.c.* (1980) 151; Corner *l.c.* 164; Keng *l.c.* 114; Turner *l.c.* (1993) 38, *l.c.* (1995) 131. **Type:** *Wallich 4331*, Peninsular Malaysia, Penang (holotype G-DC; isotype K). **Synonyms:** *I. macrophylla* var. *ovata* Loes. *l.c.* 85; *I. macrophylla* var. *angustata* Loes. *l.c.* 85, Masamune *l.c.* 416.

Tree to 24 m tall; buttresses to 60 cm tall, 60 cm wide, 5 cm thick. **Bark** smooth or rarely rough, dark grey to greyish brown or greyish white, occasionally mottled, lenticellate; inner bark often fibrous or coarsely granular, ochre-fawn to greenish brown or yellow. **Sapwood** watery, orange or white. **Twigs** *pubescent*, grey (brown when young), rarely glabrous, older twigs densely lenticillate. **Leaves** *alternate*, *subcoriaceous*, glabrous and glossy above, glabrous, paler and *epunctate below*; oblong, oblong-elliptic or ovate, *(9–)11.5–20 × (4–) 5.5–9.5 cm*, *base attenuate* or *trunctate*, margin entire, *apex acute* or *acuminate*; midrib pubescent, sunken above, glabrous and prominent below; lateral veins 6–9 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subobscure above, prominent below; intercostal venation broadly reticulate, obscure above, prominent below; *petiole pubescent*, *rarely glabrous*, *0.7–1.2 cm long*. **Inflorescences** *pubescent*, *cymose*. **Flowers** white; males (3–)4(–5)-merous; females 8–10-merous. **Fruits** globose, *(4.5–)5–6.5 mm diameter*, glossy scarlet; stalk puberulous, *c.* 3 mm long; pyrenes 6–9, sulcate.

Distribution. Peninsular Malaysia, Singapore and Borneo (Sarawak). In Sarawak, recorded only from the Semengoh FR near Kuching (e.g., *S 33000*, *S 35290* and *S 37730*).

Ecology. In primary lowland forest, at *c.* 150 m altitude.

Uses. In Peninsular Malaysia, the wood is used locally for house building, and the leaves when made into a poultice are applied to the head to cure headaches.

12. **Ilex malaccensis** Loes.

(of Malacca, Peninsular Malaysia)

Monogr. Aquifol. 1 (1901) 432; Merrill *l.c.* (1921) 353; Ridley *l.c.* (1922) 437; Masamune *l.c.* 416; Kiew, TFM 3 (1978) 8; Andrews *l.c.* (1994) 45; Turner *l.c.* (1995) 132; Coode *et al.* (eds.) *l.c.* 30; Andrews *l.c.* (1998) 30; Beaman *et al. l.c.* 117. **Lectotype** (Andrews, 1998)**:** *Beccari PB 3273*, Borneo, Sarawak, Batang Lupar, Marop Sul (hololectotype FI; isolectotypes K, P). **Synonym:** *Ilex spicata auct. non* Blume: Hooker *f. l.c.* 598, King *l.c.* 134, Ridley *l.c.* (1922) 437.

Tree to 37 m tall or *shrub*, or occasionally *epiphytic climber*. **Bark** spotted, greenish yellow or greyish brown, non-fissured. **Twigs** puberulous. **Leaves** *alternate*, *subcoriaceous* to *coriaceous*, glabrous, *prominently punctate below*; *oblong-elliptic*, rarely *linear-elliptic*, *elliptic* or *ovate*, *7–14(–17) × (1–)3–5.5 cm*, *base rounded* or *acute*, *margin entire* and *revolute*, *apex acuminate*, or *obtusely acuminate* with a rounded acumen or caudate; midrib with scattered pubescence and sunken above, sometimes puberulous and prominent below; lateral veins 7–9 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure on both surfaces; intercostal venation reticulate, usually obscure above, subprominent to obscure below; *petiole* pubescent or glabrous, *not channelled above*, *0.2–0.8 cm long*. **Inflorescences** pubescent, *spicate*. **Flowers** white, 4–5-merous. **Fruits** *barrel-shaped*, *3–3.5 mm diameter*, dark red; stalk puberulous, 2–3 mm long; *pyrenes 16–23*, *marked with fine irregular streaks*.

Vernacular name. Sarawak—*kerdam* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. In Sabah and Sarawak, widespread (e.g., *RSNB 4429*, *S 28525*, *S 33079*, *S 44931*, *SAN 25114*, *SAN 34851*, *SAN 54760*, and *SAN 131396*). Also recorded from Brunei (e.g., *Coode 6580*) and Kalimantan (e.g., *Ambriansyah AA 796*, *Endert 3558*, *Kostermans 7677*, and *Kostermans 13065*).

Ecology. Found on hillsides and ridges in lowland mixed dipterocarp forest, in *kerangas* forest, and in forest on ultramafic soils or limestone, at altitudes to 1500 m.

Notes. Malformed corollas can often be seen in specimens collected from Sarawak.

13. **Ilex megaphylla** S.Andrews

(Greek, *mega* = large, *phullon* = leaf; with large leaves)

Sandakania 11 (1998) 9. **Type:** *Anderson S 4750*, Borneo, Sarawak, G. Api (holotype SAR; isotypes A, K, L, SING).

Tree to 9 m tall. **Bark** smooth, greyish. **Twigs** thickish, drying blackish, glabrous, lenticellate. **Leaves** *alternate*, *coriaceous* and brittle when dried, glabrous and drying blackish above, brownish and glabrous and *epunctate below*; somewhat falcate, broadly oblong or oblong lanceolate, *19–35 × 5.5–13 cm*, base cuneate or cordate, margin entire, apex acuminate; midrib glabrous, sunken above, prominent below; lateral veins 18–25 pairs, subopposite to alternate, more or less parallel, ascending and looping before leaf margin, subprominent to obscure above, prominent beneath; intercostal venation broadly reticulate, sunken or subprominent above, prominent to subprominent below; *petiole* glabrous, thick, channelled above, *1–1.5 cm long*. **Inflorescences** glabrous, *in axillary compound cymes*. **Flowers** white, 4-merous. **Fruits** (very immature) ovoid, smooth.

Distribution. Endemic to Borneo. Recorded from G. Api and G. Buda in Sarawak (e.g., *S 4750*, *S 30364* and *S 39907*).

Ecology. In forest on limestone hills and cliffs, at altitudes to 1000 m.

Notes. This taxon was previously identified as *Ilex* sp. 11 in many herbaria.

14. **Ilex mesilauensis** S.Andrews

(of Mesilau, Pinosuk Plateau, Sabah)

Sandakania 11 (1998) 9; Beaman *et al. l.c.* 117. **Type:** *Chew & Corner RSNB 4885*, Borneo, Sabah, Mesilau R. (holotype SAN; isotypes A, K, L, SAR, SING). **Synonym:** *Ilex* sp. 2, Andrews *l.c.* (1994) 49.

Tree to 15 m tall. **Bark** irregularly fissured, with very large and numerous lenticels; sap from outside of wood turns green on exposure. **Twigs** *glabrous*, *dark brown*, lenticels white. **Leaves** *opposite* or *subopposite*, coriaceous, *bullate*, glabrous, *punctate below*; *spathulate* or *obovate*, *6–7.5 × 3–5 cm*, *base attenuate*, margin entire, slightly revolute, *apex emarginate*; midrib glabrous and sunken above, prominent below; *lateral veins 6–8 pairs*, opposite to subopposite, widely spaced, more or less parallel, ascending and occasionally looping before leaf margin, obscure above, subprominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole glabrous*, *0.7–0.8 cm long*. **Inflorescences** puberulous, *spicate*. **Flowers** 4-merous in bud. **Fruits** unknown.

Distribution. Endemic to Borneo; known only by a single record (*RSNB 4885*) from the Mesilau River in Sabah.

Ecology. In lower montane forest, at *c.* 1500 m altitude.

15. **Ilex nervulosa** (Loes.) S.Andrews Fig. 2.

(Latin, *nervulosus* = finely veined; the leaves)

Sandakania 11 (1998) 14. **Basionym:** *I. venulosa* Hook.*f.* var. *nervulosa* Loes. *l.c.* 90, Ridley *l.c.* (1922) 442, Kiew, Gard. Bull. Sing. 31 (1978) 82, TFM 3 (1978) 8, Turner *l.c.* (1995) 131. **Type:** *Beccari s.n.*, Singapore, Woodlands (holotype FI). **Synonyms:** *I. sclerophylloides* Loes. *forma* Airy Shaw *l.c.* (1939) 509; *Ilex* sp. 4, Coode *et al.* (eds.) *l.c.* 31.

Tree to 38 m tall. **Bark** smooth or slightly fissured, white, grey or whitish green with some mottling, somewhat corky. **Twigs** *glabrous*, *greyish* to *brownish* or *tan*, *peeling*. **Leaves** *alternate*, *coriaceous* to *thickly coriaceous*, glabrous, *punctate and not glaucous below*; oblong-ovate, elliptic to broadly elliptic, *7.5–15 × 3.5–6.5 cm*, *base cuneate*, *margin entire*, *apex acute* or

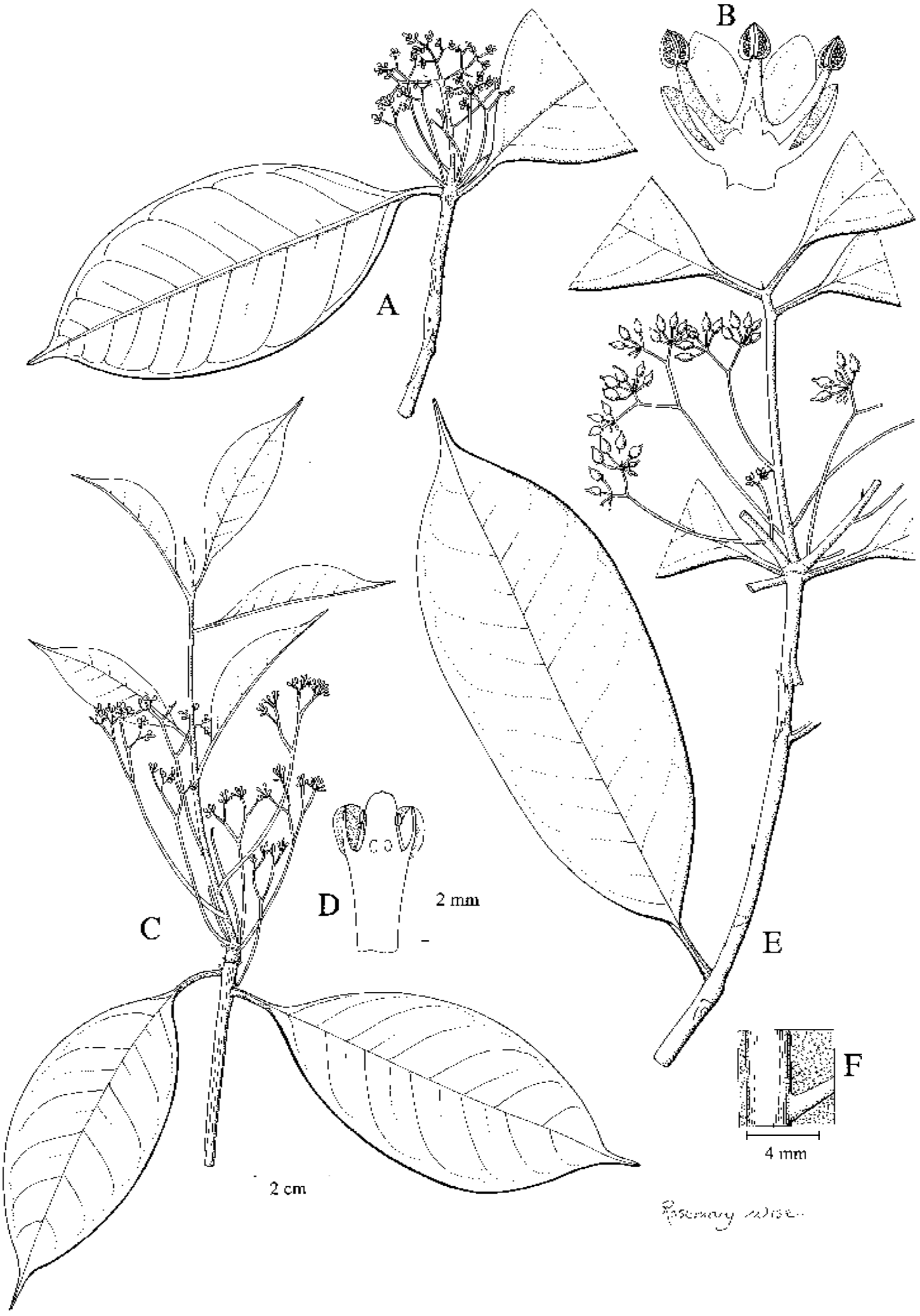


Fig. 2. *Ilex nervulosa*. A, flowering (male) leafy twig; B, longitudinal section through male flower; C, flowering (female) leafy twig; D, longitudinal section through female flower; E, fruiting leafy twig; F, detail of lower leaf surface. (A–B from *Kostermans 12790*, C–D from *SAN 102957*, E–F from *S 42203*.)

obtusely acuminate; midrib glabrous, deeply sunken above, prominent below; lateral veins 6–10 pairs, subopposite to alternate, fairly widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* glabrous, thick, *not channelled above*, *1–2 cm long*. **Inflorescences** glabrous, axillary, *in lax compound cymes*. **Flowers** greenish white; males 4-merous; females 4–7-merous. **Fruits** globose, *3–3.5 mm diameter*, red; stalk glabrous or slightly pubescent, 4–5 mm long; *pyrenes 4*, *striate*.

Vernacular names. Sabah—*kayu djung* (Obah). Sarawak—*bokol* (Land Dayak), *merkulat* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah, known from Sipitang, Weston and Lumat (e.g., *SAN 24321*, *SAN 73239*, *SAN 86354*, *SAN 105163*, and *SAN 127067*). In Sarawak, recorded from Kuching, G. Santubong East, Bako NP, Bungoh Range, Mt. Stupong and Limbang (e.g., *S 7705*, *S 17298*, *S 29047*, *S 37160*, and *S 42203*). Also known from Brunei (e.g., *S 1061* and *S 4930*) and Kalimantan (e.g., *Hallier B 2422*, *Kostermans 9290* and *Kostermans 12790*).

Ecology. Found in seasonal swamp forest, *kerangas* forest, and rocky beach forest, at altitudes to 850 m.

16. **Ilex oppositifolia** Merr.

(Latin, *oppositifolius* = with opposite leaves)

J. Arn. Arb. 20 (1939) 223; Masamune *l.c.* 416; Andrews *l.c.* (1994) 46; Beaman *et al. l.c.* 117. **Type:** *Clemens 31108*, Borneo, Sabah, Penibukan (holotype A; isotypes BM, BO, G, K, L).

Erect shrub or small tree to 20 m tall. **Bark** greyish white; inner bark greenish brown. **Sapwood** pale grey. **Twigs** puberulous, rarely glabrous. **Leaves** *sessile*, *opposite*, *rarely subopposite*, coriaceous, glabrous, *epunctate below*; *broadly elliptic* to *oblong-elliptic* or *broadly ovate*, (*4.5–*)*7–16*(*–20*) × (*3–*)*5–8.5*(*–10.5*) *cm*, *base cordate* to *subamplexicaul*, margin entire, *apex shortly acute*; midrib glabrous, sunken above, occasionally with scattered hairs below, prominent; lateral veins 5–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, sunken above, prominent below; intercostal venation laxly reticulate, sunken or subprominent above, prominent below. **Inflorescences** puberulous, *in compound cymes*. **Flowers** white or pink or purplish pink edged with white outside, white inside; males 5–6(–8)-merous; females 8–14-merous. **Fruits** globose, 2–5 mm diameter, reddish black; stalk puberulous, *c.* 3 mm long; pyrenes 4–9, sulcate.

Distribution. Endemic to Borneo (Sabah). In Sabah, recorded from Mt. Kinabalu, Bt. Taviu and Mt. Silam (e.g., *Andrews 866*, *Andrews 870*, *Clemens 32557*, and *Clemens 40539*).

Ecology. Occurring in hill to lower montane forests on ultramafic soils near ridge tops or crests of rocky spurs, at 500–1500 m altitude.

Notes. *Ilex oppositifolia* is closely related to *I. zygophylla* but the latter only occurs in Mt. Kinabalu area, and usually seen as a shrub with petioles 2–7 mm long and the leaf base is subcordate, never subamplexicaul.

17. **Ilex orestes** Ridl.

(Greek, *orestes* = of the mountain; its natural habitat)

Bull. Misc. Inf., Kew 1 (1931) 35; Masamune *l.c.* 416; Anderson *l.c.* (1980) 151. **Type:** *Native Collector D167*, Borneo, Sarawak, Mt. Santubong (holotype E; isotypes K, SAR). **Synonym:** *I. havilandii* Loes. var. *major* W.W.Smith, Notes Roy. Bot. Gard. Edin. 4, 40 (1915) 323, Masamune *l.c.* 415.

Shrub or tree to 8 m tall. **Twigs** *greyish brown*, *puberulous*, somewhat channelled when dried. **Leaves** *alternate*, or *subopposite*, *rarely opposite*, *coriaceous*, *not bullate*, glabrous, *punctate on both surfaces*; *obovate* or *oblong-ovate*, *3.5–6.5 × 2–4.5 cm*, *base cuneate*, *margin entire*, revolute, *apex retuse*; midrib glabrous and deeply sunken above, with scattered hairs and prominent below; *lateral veins 3–5 pairs*, subopposite to alternate, widely spaced, ascending and obscure before leaf margin, sunken above, prominent to subprominent below; intercostal venation obscure on both surfaces; *petiole puberulous*, *c. 0.2 cm long*. **Inflorescences** puberulous; male flowers *in axillary racemes*; female flowers *in condensed axillary racemes*. **Flowers** white or pale cream, 4–5-merous. **Fruits** globose, *c.* 3 mm diameter, purplish and closely wrinkled when dried; stalk pubescent, 1.5–2.5 mm long; *pyrenes 6–8*, *sulcate* to *somewhat smooth*.

Vernacular names. Sarawak—*kerdam* (Malay), *termiang* (Iban).

Distribution. Endemic to Borneo (Sarawak). Recorded from Mt. Matang, Mt. Santubong, and Bungoh Ranges in Sarawak (e.g., *S 7616*, *S 37114*, *S 43652*, and *S 44763*).

Ecology. In forest on summit ridges, at altitudes to 1000 m.

18. **Ilex promecophylla** S.Andrews

(Greek, *promecophylla* = with oblong leaves)

Sandakania 11 (1998) 11; Beaman *et al. l.c.* 117. **Type:** *Fedilis & Sumbing SAN 110918*, Borneo, Sabah, Ulu Sg. Pingas-Pingas (holotype SAN; isotypes K, KEP, L, SAR). **Synonym:** *Ilex* sp. 5, Coode *et al.* (eds.) *l.c.* 31.

Tree to 25 m tall. **Bark** smooth, dark brown, grey, whitish cream or yellowish grey, granular; inner bark very thin, variable in colour, often brownish grey or yellow. **Sapwood** pale yellow or almost white. **Twigs** glabrous, pale coloured, not peeling. **Leaves** *alternate*, *coriaceous*, glabrous above, glabrous, pale coloured, and *punctate below*; *oblong*, *obovate-oblong* or *broadly obovate-oblong*, *10.5–17(–24) × 4.5–6.5(–10) cm*, *base cuneate*, *margin entire*, *apex mucronate* or *retuse*, *rarely obtuse*; midrib glabrous, sunken above, prominent below; lateral veins 6–8(–13) pairs, subopposite to alternate, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure above, subprominent below; *petiole* glabrous, *not channelled above*, *2–3 cm long*. **Inflorescences** *glabrous*, *rarely puberulous*, *in compound cymes*. **Flowers:** males white to greenish white, 4–6-merous; females unknown. **Fruits** globose, *5–9 mm diameter*, red; stalk glabrous, rarely puberulous, 5–10 mm long; pyrenes 4–6, striate-sulcate.

Distribution. Endemic to Borneo. In Sabah, found in Nabawan and Trus Madi FR in Keningau district, Ulu Sg. Pingas Pingas in Kinabatangan district, G. Lumaku FR in Sipitang district, and in a few other localities (e.g., *SAN 43152*, *SAN 104342*, *SAN 110918*, and *SAN 119226*). In Sarawak, recorded only from the Lambir NP (e.g., *S 40251*). Known also from Brunei (e.g., *BRUN 1*, *S 1504* and *S 3114*).

Ecology. Primary forest on slopes and along ridges, on sandy yellowish and black rocky soils, at altitudes to 1500 m.

19. **Ilex spicata** Blume

(Latin, *spicatus* = bearing a spike; referring to the spicate inflorescence)

Bijdr. Fl. Ned. Ind. (1827) 1149; Stapf *l.c.* 139; Loesener *l.c.* 428; Merrill *l.c.* (1921) 353; Masamune *l.c.* 412; Backer & Bakhuizen *f. l.c.* 52; Meijer *l.c.* 89; Andrews *l.c.* (1994) 47; Beaman *et al. l.c.* 118. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *Prinos spicata* (Blume) Miq. *l.c.* (1859) 594.

Shrub or tree to 13.5 m tall, or more often epiphytic or climbing. **Bark** smooth, white or silvery grey; inner bark white. **Sapwood** white. **Twigs** glabrous. **Leaves** *alternate*, *coriaceous*, glabrous, *punctate below*; *elliptic*, *ovate* or *oblong-ovate*, *5–8.5(–13) × 2.5–4.5(–6) cm*, *base rotundate*, *margin entire*, *apex long-acuminate*; midrib glabrous and deeply sunken above, glabrous and prominent below; lateral veins 5–7(–8) pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole* glabrous, *not channelled above*, *0.1–1.2 cm long*. **Inflorescences** glabrous, *spicate* and slightly twisted. **Flowers** creamy white, 4–6-merous. **Fruits** globose, *2.5–5 mm diameter*, reddish ripening to purplish black; stalk glabrous, 3–5 mm long; pyrenes 4–6, centrally sulcate.

Key to varieties

Petiole 0.7–1.2 cm long..

var. **spicata**

Sumatra, Java, Borneo, and Sulawesi. In Sabah, known from Lamag area, Mt. Alab, Mt. Kinabalu and Mt. Tambuyukon (e.g., *Andrews 1593*, *Clemens 31557*, *SAN 42798*, *SAN 60360*, and *SAN 60643*). Also known in Kalimantan (e.g., *Hallier 1691*, *Hallier 3419*, *Mogea 3942*, and *Mogea 3968*). In primary lower montane forest, at altitudes to 1800 m altitude.

Petiole 0.1–0.2(–0.4) cm long...

var. **harmsiana** (Loes.) S.Andrews

(H.Harms, 1870–1942, former botanist at the Botany Museum, Berlin, Germany)

Sandakania 11 (1998) 13. Basionym: *I. harmsiana* Loes. *l.c.* 433, Merrill *l.c.* (1921) 352, Masamune *l.c.* 415, Beaman & Anderson *l.c.* 112. Type: unknown. Synonym: *Ilex* sp. 1 ?*spicata auct. non* Blume: Coode *et al.* (eds.) *l.c.* 30.

Endemic to Borneo. In Sarawak, recorded from several localities (e.g., *Argent & Jermy 1031*, *Beaman 11468*, *S 25739*, *S 30927*, and *S 52485*). In hill and montane forests and on limestone ridges, at altitudes to 2300 m. Also occurs in Brunei (e.g., *Coode 7421*, *Dransfield JD 7153* and *Wong WKM 757*). Vernacular names: Sarawak—*bupok*, *wa bupok* (Kelabit). Uses: For stomach ache. Boil young leaves in water to make a drink (Sarawak). Notes: This taxon has been confused with *Diplycosia heterophylla* Blume var. *latifolia* (Blume) Sleumer in the Ericaceae.

20. **Ilex triflora** Blume

(Latin, *triflorus* = three-flowered; the inflorescence)

Bijdr. Fl. Ned. Ind. (1827) 1150; Loesener *l.c.* 344; Ridley *l.c.* (1922) 438; Backer & Bakhuizen *f. l.c.* 52; Kiew, Gard. Bull. Sing. 31, 2 (1978) 81; Corner *l.c.* 65; Andrews *l.c.* (1994) 48; Turner *l.c.* (1995) 132; Coode *et al.* (eds.) *l.c.* 31; Beaman *et al. l.c.* 118. **Type:** *Blume s.n.*, Java (holotype L; isotypes BO, K). **Synonyms:** *I. horsfieldii* Miq. *l.c.* (1859) 594; *I. lobbiana* Rolfe *l.c.* 309; *I. griffithii* Hook.*f. l.c.* 601, King *l.c.* 135; *I. triflora* Blume var. *lobbiana* (Rolfe) Loes. *l.c.* 346, Merrill *l.c.* (1921) 353, Ridley *l.c.* (1922) 438, Masamune *l.c.* 417; *I. triflora* Blume var. *horsfieldii* (Miq.) Loes. *l.c.* 347; *I. triflora* Blume var. *javensis* Loes. *l.c.* 347; *I. polyphylla* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 45, Ridley *l.c.* (1922) 438, Kiew, TFM 3 (1978) 81; *I. triflora* Blume var. *longifolia* Ridl. *l.c.* (1922) 438, Airy Shaw *l.c.* (1939) 511.

Shrub or small tree to 8 m tall, *occasionally epiphytic*. **Bark** smooth, silvery grey to brownish grey. **Twigs** shortly puberulous, rarely densely so, channelled when dried. **Leaves** *alternate*, *coriaceous*, glabrous above, usually glabrous and *prominently punctate below*; elliptic to ovate, *1–9.7 × 0.6–4 cm*, base cuneate, *margin crenate* or *serrate throughout*, *apex acute* or *acuminate*; midrib puberulous and sunken above, scattered puberulous and prominent below; lateral veins 4–7 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure to subprominent on both surfaces; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* puberulous, *0.2–1 cm long*. **Inflorescences** puberulous, cymose. **Flowers** white or pale pink to purplish, 4-merous. **Fruits** ellipsoid or globose, 6.5–7.5 mm diameter, purplish black to black, closely wrinkled when dried; stalk puberulous, 5–13 mm long; pyrenes 4, striate.

Distribution. N India, tropical China, Hong Kong, Thailand, Laos, Vietnam, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and Maluku. In Sabah, uncommon, found on Mt. Kinabalu and Mt. Lotung (e.g., *Andrews 824*, *Clemens 26995* and *SNP 2738*). In Sarawak, recorded from Mt. Dulit, Mt. Mulu, Bt. Lawi, Bt. Pagon Kecil and Bt. Braang (e.g., *Nielsen 852*, *Nooteboom & Chai 2264*, *S 37385*, *S 38769*, and *S 50883*). Also known from Brunei (e.g., *BRUN 2348*, *S 8316* and *Wong WKM 1857*) and Kalimantan (e.g., *Donald & Ismail 4155*, *Hallier 2483* and *Teijsmann 11237*).

Ecology. In hill and lower montane forests or on ridge tops, at altitudes to 2300 m.

Notes. A widespread and extremely variable species in its leaf morphology, which is impossible to separate out on a geographic basis. Small-leaved collections have previously been identified as *Ilex* sp. 19 in several herbaria.

21. **Ilex wallichii** Hook.*f.* Fig. 3.

(Nathaniel Wallich, 1786–1854, Danish botanist at Calcutta)

Fl. Brit. Ind. 1 (1875) 605; Loesener *l.c.* 72; Coode *et al.* (eds.) *l.c.* 31; Beaman *et al. l.c.* 118. **Type:** *Gomez 150*, Burma, Tavoy (holotype K; isotype K-W). **Synonyms:** *I. sclerophylloides* Loes. *l.c.* 77, Merrill *l.c.* (1921) 353, Ridley *l.c.* (1922) 440, Masamune *l.c.* 416, Anderson *l.c.* (1972) 26, Kiew, TFM 3 (1978) 9, Anderson *l.c.* (1980) 151, Turner *l.c.* (1995) 132; *I. mattangicola* Loes. *l.c.* 115, Merrill *l.c.* (1921) 353, Masamune *l.c.* 416.

Shrub or tree to 18 m tall. **Bark** smooth, white or grey; inner bark yellow, brown or greenish opaque, with fine striations near the cambium, brittle. **Sapwood** white to yellow. **Twigs** glabrous, white, peeling. **Leaves** *alternate*, *coriaceous*, glabrous on both surfaces, *epunctate below*; oblong to elliptic-oblong or obovate, (*5–*)*6.5–13* × (*1.5–*)*4–7 cm*, *base cuneate*, margin entire, *apex mucronate*, *retuse* or *acuminate*; midrib glabrous, sunken above, prominent below; lateral veins 5–7 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subprominent above, prominent to subprominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* glabrous, *0.6–1 cm long*. **Inflorescences** *cymose*, usually *glabrous on primary pedicels*, pubescent on secondary pedicels. **Flowers** greenish white; males 4–6-merous; females 10–13-merous. **Fruits** oblong or globose, smooth, *8.5–9.5 mm diameter*, dark red to blackish red; stalk pubescent, thickened at apex, 1.3–4.5 mm long; pyrenes (7–)9–12, smooth.

Vernacular names. Sabah—*mengkulat* (preferred name). Sarawak—*kerdam* (Melanau), *kerdam daun kechil* (preferred name).

Distribution. Burma, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Sabah and Sarawak, common (e.g., *SAN 36256*, *SAN 49607*, *S 32771*, *S 42748*, and *S 48104*). Also known from Brunei (e.g., *BRUN 2463*, *SAN 17459* and *S 2857*) and Kalimantan (e.g., *Endert 2013*, *Kostermans 9259*, *Kostermans 9590*, *Kostermans 13076*, and *Meijer 1037*).

Ecology. Locally common, occuring in *Dacrydium-Casuarina kerangas* forest and primary peat swamp forest, at altitudes to 1000 m.

22. **Ilex zygophylla** Merr.

(Greek, *zygophyllum* = with paired or opposite leaves)

J. Arn. Arb. 20, 2 (1939) 224; Masamune *l.c.* 417; Meijer *l.c.* 89; Andrews *l.c.* (1994) 48; Beaman *et al. l.c.* 118. **Type:** *Clemens 51073*, Borneo, Sabah, Mt. Kinabalu, Gurulu Spur (holotype A; isotypes G, L, UC).

Shrub or treelet to 5(–10) m tall. **Leaves** *opposite* or *subopposite*, coriaceous, puberulous, rarely glabrous above, less so and *epunctate below*; *ovate*, *obovate* or *elliptic*, (*1.5–*)*4–7* × *1.5–4.5*(*–5*) *cm*, *base subcordate*, margin entire, revolute, *apex acute* or *mucronate*; *petiole* puberulous, *0.2–0.7 cm long*. **Inflorescences** puberulous, *in compound cymes*. **Flowers:** males 4–6-merous; females 6–13-merous, pink in bud, opening white. **Fruits** globose, 4–5 mm diameter, purple; pyrenes 6–9, sulcate to striate.

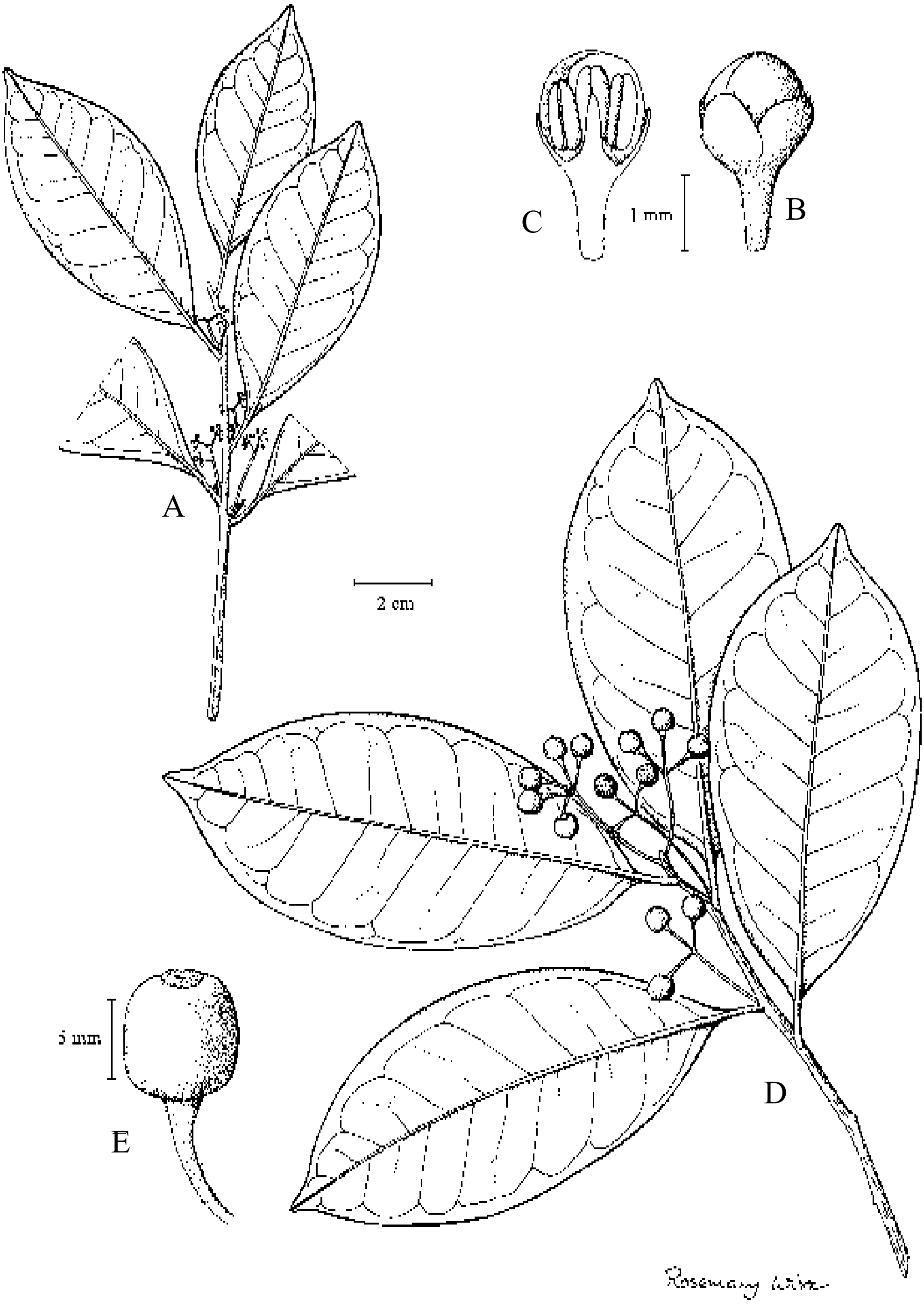


Fig. 3. *Ilex wallichii.* A, flowering (male) leafy twig; B, immature male flower bud; C, longitudinal section through immature male flower bud; D, fruiting leafy twig; E, fruit and stalk. (A–C from *S 23148*, D–E from *SAN 49518*.)

Distribution. Endemic to Borneo, occurring on Mt. Kinabalu, Pig Hill and Mt. Tambuyukon in Sabah (e.g., *Andrews 887*, *Clemens 51073*, *SAN 21054*, *SAN 29260*, and *SAN 38419*).

Ecology. In open montane forest on ultramafic soils, at 2300–3300 m altitude.

EBENACEAE

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Hiern, Trans. Cambr. Phil. Soc. 12, 2 (1873) 27; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 412; Merrill, EB (1921) 601, PEB (1929) 240; Ridley, FMP 2 (1923) 278; Bakhuizen, Gard. Bull. S. S. 7 (1933) 161, Bull. Jard. Bot. Buitenz. 3, 15, Part 1 (1936) 3, Part 2 (1937) 50, Part 3 (1938) 179, Part 4 (1941) 369, and Part 5 (1955) plates 1–92; Masamune, EPB (1942) 601; Backer & Bakhuizen *f.*, FJ 2 (1965) 184; Ng, Malay. For. 40 (1977) 210, TFM 3 (1978) 56; Anderson, CLTS (1980) 167; Whitmore, Tantra & Sutisna, CLK 1 (1990) 88; Turner, Gard. Bull. Sing. 47 (1995) 196; Coode *et al.* (eds.), CLBD (1996) 87; Argent *et al.* (eds.), MNDT-CK 1 (1997) 176; Beaman *et al.*, PMK 4 (2001) 226.

A family of two genera of small to big trees: *Euclea* (12 species in Africa) and *Diospyros* (*c.* 500 species worldwide).

DIOSPYROS L.

(Greek, *dios* = god, *puros* = wheat or fruit; alluding the edible persimmon fruit)

kayu arang, *kayu malam* (Malay)

Sp. Pl. 2 (1753) 1057, Gen. Pl. 5th edition (1754) 478; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 417; Merrill, EB (1921) 601, PEB (1929) 240; Ridley, FMP 2 (1923) 281; Bakhuizen, Gard. Bull. S. S. 7 (1933) 161; Bull. Jard. Bot. Buitenz. 3, 15, Part 1 (1936) 6; Backer & Bakhuizen *f.*, FJ 2 (1965) 184; Ng, TFM 3 (1978) 57; Anderson, CLTS (1980) 167; Whitmore, Tantra & Sutisna, CLK 1 (1990) 88; Coode *et al.* (eds.), CLBD (1996) 87; Argent *et al.* (eds.), MNDT-CK 1 (1997) 176; Beaman *et al.*, PMK 4 (2001) 226. **Synonym:** *Maba* J.R. & G.Forst., Char. Gen. Pl. (1776) 121, King & Gamble *l.c.* 412, Ridley *l.c.* (1923) 279.

Dioecious (very rarely monoecious) trees *without latex*. Outer bark in most species characteristically thin, black, hard and finely longitudinally cracked or fissured; slash inner bark and sapwood mostly white to cream but in some species bright yellow, immediately or soon after exposure to air. **Leaves** *simple*, *alternate*, *entire*, *exstipulate*, *petiolate*, drying yellowish, dark brown or black on one or both sides. **Inflorescences** *cymose* (with basic cymose unit of 3, 5 or 7 flowers, sometimes reduced to one flower, sometimes branching to carry multiple units), axillary (except for *D. diepenhorstii* where inflorescences are borne on larger branches and tree trunk), bracteate, usually shorter than leaves, males tending to have more flowers per inflorescence than females. **Flowers** *unisexual* (sporadically bisexual), *articulated at base*, *radially symmetrical*, 3–5(–8)-merous; *calyx* united at base, distally divided into lobes or teeth, or truncate (not so divided), if lobed, the lobes imbricate (overlapping) or valvate (not overlapping), *persistent in fruit*; corolla with a narrow (salverform) or bulging (urceolate) tube bearing spreading lobes at the mouth. **Male flowers:** stamens (3)–12–20(–100), attached to the base of corolla tube, rarely towards the mouth, sometimes on the receptacle, usually not or only slightly protruding out of the mouth, often in two whorls; anthers *basifixed*, usually longer than filaments, 2-locular, dehiscing by longitudinal slits; filaments free or united in pairs, triads or larger fascicles, or even into a single column; pistillode represented by a small sterile lump of tissue or absent or sometimes well-formed enough in the central flower of a male cyme to be functionally female. **Female flowers:** *ovary superior*, *multilocular*, *2–8-carpellate as indicated by the number of styles or stigmatic lobes*, *each carpel corresponding to one biovulate locule or two uniovulate locules* (the uniovulate condition resulting from the development of a 'false' septum between the primarily paired ovules); ovules *pendulous*, anatropous, bitegmic; staminodes reduced to a single whorl of sterile epipetalous lobes or absent. **Fruit** a *berry*; pericarp fibrous or fleshy, in some species, differentiated into three layers: an inner fleshy endocarp around each seed which may be mistaken for a sarcotesta, a fleshy to fibrous mesocarp, and an outer exocarp (skin). **Fruit calyx** remaining the same size as in flowers (not accrescent), or becoming enlarged in fruit (accrescent). **Seeds** 1–16, *arranged in a single whorl around central axis*, with thin coriaceous testa and *thick horny endosperm*; embryo straight or slightly curved, with flat leafy cotyledons and a *prominent radicle as long as or longer than cotyledons*; where there are three or more seeds in a fruit, the *seeds wedge-shaped*, *like segments of an orange*, *with an unbranched circumperipheral vascular strand running along the inner edge and round the back*; in only a few species (e.g. *D. maingayi*) is the vascular strand branched over the surface of the seed. **Germination** of most species epigeal; a few hypogeal or durian.

Other vernacular names. Sabah—*parong* (Dusun), *sitam* (Murut). Sarawak—*bagoa* (Bidayuh, Bau), *balih* (Iban), *gigi* (Bidayuh, Bau), *kayu birang* (Berawan), *kayu lusang* (Kenyah), *kayu padang* (Punan, Tutoh), *kayu tam* (Kayan), *merpinang* (Iban), *pangkabar* (Bidayuh, Padawan).

Distribution. About 500 species, in Asia, Africa, N, S and C America, Australia and the South Pacific Islands, mostly tropical or subtropical. Absent in Europe except for *D. lotus*, naturalised in the Mediterranean region, which may have been introduced from east Asia along the ancient overland trading routes (Ng, Malay. For. 42 (1979) 165). In Sabah and Sarawak, a total of 75 species are recognised.

Ecology. Species of *Diospyros* are found from coastal sandy or rocky shores up to lower montane mossy forests, including limestone hills and peat swamps. They are absent from mangrove forests. Regeneration failure (in species with epigeal germination) may occur due to mortality at the germination stage after the hypocotyl has begun to elongate and lift the seed body out of the soil. At this stage, the seed coat should be cast off by the expansion of the cotyledons and plumule; if not, the trapped cotyledons and plumule will decay and the seedling will die. Wright (Ann. Roy. Bot. Gard. Peradeniya 2 (1904) 1) called this "suicidal germination", a phenomenon also observed in some other plants, e.g. in Euphorbiaceae and Flacourtiaceae (Ng, MFFSS 1 (1991) 61 & 67). Such seedlings may be saved if the seed coat and endosperm are manually removed before decay sets in.

Timber. The timber is very fine-grained, dense, dimensionally stable, usually pale yellow in colour, and anatomically quite uniform throughout the genus. In a few species, the heartwood is durable and dark brown to black or streaked black; these are the famous ebonies of commerce, now very scarce. The main producers of ebony are tropical Africa, India, Sri Lanka and the islands of eastern Indonesia, where there is a prolonged dry season. The wood of ordinary (non-ebony) *Diospyros* is less durable but nevertheless attractive because of its density, fineness of grain, and dimensional stability; it can be stained black if so desired. As timber, *Diospyros* spp. have been ignored in Malaysia because the trees are mostly medium-sized, while the industry has been shaped and dominated by the availability of big trees such as those of Dipterocarpaceae. *Diospyros* would be an excellent candidate for consideration in any programme to grow high value timber.

Uses. Ebony has been traded for over 2000 years as a fancy wood for fine furniture, wood carvings, the black keys of classic pianos, etc. The wood of the American *D. virginiana* has been used for the heads of golf clubs.

The fruits of several species are edible, and the name of the genus alludes to this. Of these, the most popular is the oriental persimmon, *D. kaki*, one of the classic fruits of China and Japan. This is a hexaploid (2n = 90), probably derived from the diploid (2n = 30) subtropical *D. roxburghii* (Ng, Malay. For. 41 (1978) 43) by polyploidy and selection for frost hardiness. *D. kaki* is now cultivated in many temperate countries and in the tropical highlands; a few trees have been grown in Kuching at almost sea level, and have fruited regularly. Other edible cultivated persimmons are *D. lotus* (Japan, across Eurasia to the West Asia and the Mediterranean, with a subspecies *brideliifolia* in the Philippines), *D. digyna* (C America) and *D. blancoi* (the Philippines). In this revision a forest species in Borneo is determined as the wild type of *D. blancoi.* Other wild species in SE Asia known to have edible fruits include *D. argentea*, *D. diepenhorstii*, *D. macrophylla* and *D. pyrrhocarpa*. The species with most potential are those with the whole pericarp edible, but in most forest species, the edibility is restricted to the thin layer of endocarp (pseudo-sarcotesta) around the individual seeds.

The fruits of all species are high in tannin-content which make them completely inedible until fully ripened. The tannin has been used to toughen and preserve fishing nets.

The fruits of several species (e.g. *D. piscicarpa*, *D. styraciformis* and *D. wallichii*) are used to stupefy fish. The species used in this way are usually called *tuba* or some variation of it (*buah tuba*, *tuba api*, *tuba monyet*, etc). The name *tuba* is also applied to *Derris elliptica* and some other species of *Derris*, the roots of which are pounded to release sap, which when cast into a river, cause fish to be stunned. Such fish float to the surface and can be easily scooped up. The (immature) fruits of *Diospyros* are pounded in the same way to release a red or black sap and cast into the water to produce the same result. This method of fishing has been discovered independently on the opposite side of the world, in the West Indies, where the immature fruits of the local species *D. ebenaster* (a synonym of *D. digyna*) are used (Burkill EPMP 1 (1966) 842). This parallels the use of *Derris* in fishing which has also developed independently in tropical Asia and tropical America.

The fruits of several species of *Diospyros* were believed by Bakhuizen to be palatable but poisonous to humans. Among these he named *D. perfida*, *D. insidiosa* and *D. daemona* in allusion to their allegedly perfidious, insidious and demonic nature. Eight men on patrol in Sigli, Sumatra had reportedly eaten the fruits of *D. insidiosa* (which must have been very tasty) and become ill; one of them died. The identification was based on a half-eaten fruit, but Bakhuizen was not sure whether it was *D. insidiosa* or *D. perfida*, so he gave both a bad name. *D. daemona* was considered poisonous by taxonomic association because in Bakhuizen's classification scheme, it came next to *D. insidiosa*. However, another species placed next to *D. insidiosa* was *D. diepenhorstii*, which is safely edible. The claim that some *Diospyros* fruits can be palatable but poisonous is therefore unproven. The men could have been struck by virus. The poisoning of fish using immature astringent fruits is a different matter.

In India, a local industry is based on *D. melanoxylon* leaves, which are dried, rolled and used as *bidi* cigarettes.

In ornamental horticulture, small-leafed species are valued for bonsai culture, especially in Thailand. In Malaysia, *D. ferrea* may be used for the same purpose. In the Philippines, *D. blancoi* is a popular ornamental roadside tree.

Reproductive biology. *Diospyros* is generally dioecious, i.e. with separate male and female trees, but there is some variation in the expression of sexuality. In *D. wallichii*, which is a common wild tree in secondary forest in Kepong, the sexes seem to be absolutely separate. In this species, a male tree never bears fruits. However, the situation is different with *D. ismailii*, where trees grown from seeds produce female trees which are consistently female, and male trees which regularly bear a small percentage of bisexual flowers, usually the central flower in a cyme. Such bisexual flowers may produce fruits. In *D. digyna*, a planted single female tree has been observed to bear seedless fruits only, but on one occasion, it produced a fruit with a full complement of seeds even when there were no male trees anywhere in the vicinity. The cultivated *D. kaki* is usually monoecious, with the central flower of the cyme bisexual, flanked by male flowers.

Taxonomy. Despite the large number of species and the wide geographical distribution of *Diospyros*, all members of the genus are easy to recognise in the field because of their consistent and characteristic architecture of monopodial trunk bearing spirally arranged leaves, and intermittent pseudowhorls of distichous branches. Such trees belong to the architectural model of Massart (Halle, Oldeman & Tomlinson, Tropical Trees and Forests (1978) 1). Other common trees belonging to this model are the Myristicaceae (which can be distinguished by the red sap when the bark is slashed) and *Dipterocarpus* (which is distinguished by stipules). The Malay name *kayu arang* (= charcoal wood) alludes to the black hard outer bark which in some species may become thick and conspicuous. Such bark also develops in some members of the Myristicaceae which are called *penarahan arang*. The Ibans in Brunei apply the name *kayu balik* to several species of *Diospyros* (*D. borneensis*, *D. elliptifolia*, *D. lanceifolia*, *D. styraciformis*, and *D. wallichii*) of which the inner bark and sapwood turn bright yellow when cut.

The ovary, fruit and seed of *Diospyros* are anatomically absolutely distinctive and diagnostic of the genus. The form of the persistent calyx of *Diospyros*, together with the fruit size and stalk length, provide important characters for the delimitation of species. It is important to distinguish between calyx lobes that are imbricate (overlapping), valvate (not overlapping) or truncate (without lobes) and calyces which are accrescent (enlarged with the fruit) or not accrescent.

Bakhuizen *l.c.* (1936–41) divided the genus into 4 subgenera and 34 sections. His classification proved to be unsustainable. Three of his species, although described in detail, were not even *Diospyros* (Ng, Blumea 18 (1970) 412): *D. hierniana* (King & Gamble) Bakh. proved to be *Salacia grandiflora* Kurz (Celastraceae), *D. micromera* Bakh. was *Cleistanthus nitidus* Hook. *f.* (Euphorbiaceae) and *D. sororia* Bakh. was *Ilex borneensis* Loes. (Aquifoliaceae). In other cases, species that he placed in different sections have turned out to be components of a single variable species.

Most of the species are variable within narrow limits, but a few are extremely variable, either in leaf morphology (e.g., *D. andamanica* and *D. sumatrana*) or fruit calyx morphology (e.g., *D. mindanaensis*), or both (*D. pilosanthera*). Wherever possible, the variable species have been divided into varieties but in some cases, subdivision cannot be carried out without leaving many specimens without a home. For example, if varieties are defined by the form of the fruiting calyx, many non-fruiting specimens (including male specimens) would be homeless. In such species, no subspecific subdivision is recognised. In 1977, Kostermans described many new species of *Diospyros*. Many of these have turned out to be no more than extreme forms of previously described variable species.

Key to *Diospyros* species

1. Leaves with invisible intercostal venation……………………………………………2
   Leaves with visible (faint to prominent) intercostal venation on one or both sides of the leaf……………………………………………………………………………17

2. Twigs and both sides of leaves drying consistently black………………………3
   Twigs and leaves drying not so…………………………………………………………6

3. Leaves elliptic or ovate……………………………………………………………………4
   Leaves obovate, oblong-ovate, oblong-elliptic, or oblong and parallel-sided…......5

4. Leaves 8–20 × 5–11 cm……………………………………………**44. D. maingayi**
   Leaves 3.5–10 × 1.2–4 cm………………………………………**57. D. puncticulosa**

5. Leaves coriaceous, mostly obovate, with apex rounded, retuse or acute (rarely acuminate)……………………………………………………………**26. D. evena**
   Leaves membranaceous, oblong-ovate or oblong and parallel-sided, with apex acuminate……………………………………………**12. D. confertiflora** (in part)

6. Leaves oblong and parallel-sided…………………………………………………………7
   Leaves of other shapes and not parallel-sided…………………………………………8

7. Twigs bearing spreading 0.2 cm long hairs. Leaves 1.5–4 × 0.5–1 cm………………………………………………………………………………………………**11. D. clementium**
   Twigs glabrous or bearing hairs shorter than 0.1 cm. Leaves 2.5–9 × 1–3.5 cm………………………………………………………………**12. D. confertiflora** (in part)

8. Leaves glaucous below.......... **36. D. havilandii**
Leaves not glaucous below.......... 9

9. Leaves narrow and willow-like, 6–11 × 0.7–2 cm, long-tapered to apex and base.......... **40. D. lanceifolia** (in part)
Leaves not narrow and willow-like.......... 10

10. Leaves longer than 7 cm.......... 11
Leaves shorter than 7 cm.......... 13

11. Lateral veins 3–5 pairs.......... **64. D. singaporensis** (in part)
Lateral veins 7–10 pairs.......... 12

12. Twigs and leaves glabrous.......... **51. D. pendula**
Twigs and leaf undersurface densely appressed hairy, at least in young parts.......... **5. D. blancoi** (in part)

13. Female inflorescences (excluding flowers) 0.1–0.2 cm long. Fruits subsessile... 14
Female inflorescences (excluding flowers) 0.5–2.5 cm long. Fruits stalks 0.5–2.5 cm long.......... 15

14. Leaf base attenuate; male flowers solitary, corolla salverform, *c.* 0.8 cm long. Fruits globose.......... **65. D. squamaefolia**
Leaf base cuneate, rarely attenuate; male flowers in clusters of 2–5, ovoid or globose in bud, *c.* 0.2 cm long. Fruits ellipsoid.......... **9. D. buxifolia**

15. Leaves obovate, with apex rounded, acute or shortly acuminate. Fruits ellipsoid.......... **50. D. parabuxifolia**
Leaves elliptic or rhombic, with apex acuminate to caudate. Fruits globose.... 16

16. Fruits *c.* 1.5 cm diameter, thin-walled (wall brittle and often crushed in drying).......... **34. D. graciliflora**
Fruits 2.5–3.5 cm diameter, thick-walled (wall not puckered nor crushed in drying).......... **64. D. singaporensis** (in part)

17. Leaves with pronounced intramarginal veins (result of lateral veins inarching and linking up at the margins and the linked portions strengthened as a continuous vein).......... 18
Leaves without intramarginal veins (lateral veins diminishing till inconspicuous, or if inarching, the arches not strengthened as a continuous vein).......... 23

18. Leaves densely hairy below.......... **40. D. lanceifolia** (in part)
Leaves glabrous below.......... 19

19. Intramarginal veins distant from leaf margin, leaving a marginal space about one-third of the midrib-to-margin width.......... 20
Intramarginal veins very close to the margin.......... 21

20. Lateral veins and intercostal venation sunken on the leaf uppersurface. Fruits on 0.8–1.3 cm stalks; fruit calyx leafy-coriaceous, erect, outstretched and prominently veined............ **48. D. neurosepala**
Lateral veins and intercostal venation flush or prominulous on the leaf uppersurface. Fruits subsessile; fruit calyx lobes with sides reflexed to almost touch each other, not visibly veined............ **7. D. brainiana**

21. Intercostal venation reticulate............ **31. D. foxworthyi**
Intercostal venation scalariform............ 22

22. Calyx (both male and female) truncate. Leaves oblong, elliptic or ovate............ **6. D. borneensis**
Calyx divided into 4–5 valvate lobes. Leaves oblong or oblong-obovate............ **4. D. beccarioides**

23. Intercostal venation scalariform, spaced 0.1–0.2 cm apart............ 24
Intercostal venation reticulate, areolate, or laxly scalariform............ 27

24. Leaf base subcordate. Twigs and leaf undersurface densely hairy with spreading hairs all over............ **52. D. penibukanensis** (in part)
Leaf base rounded to cuneate. Twigs and leaf undersurface not densely hairy all over............ 25

25. Fruits ellipsoid, *c.* 1 × 0.5 cm............ **23. D. eriantha**
Fruits globose to depressed ovoid, 2.6–5.5 cm diameter............ 26

26. Fruits on 0.5–1 cm long stalks............ **37. D. keningauensis**
Fruits subsessile on 0.1–0.2 cm long stalks............ **41. D. lateralis**

27. Leaves subglaucous below, elliptic. Trees of peat swamps............ **62. D. siamang**
Not this combination............ 28

28. Leaves oblong-obovate, 20–40 cm long, with rounded, subcordate or cordate base. Bark of twigs corky............ **25. D. euphlebia**
Not this combination............ 29

29. Leaves oblong, 13–50 cm long, with rounded to subcordate base. Inflorescences borne on the larger branches and on the trunk. Fruits to *c.* 10 × 6 cm, vertically ribbed; fruit calyx forming a shallow cup with 6 shallow lobes............ **20. D. diepenhorstii**
Not this combination............ 30

30. Leaves narrow, willow-like, tapered gradually to base and apex............ **24. D. eucalyptifolia**
Not this combination............ 31

31. Leaves elliptic to obovate, with attenuate base; lateral veins 5–12 pairs, prominulous on both sides of the leaf, steeply ascending and forming multiple loops in the apical half of the leaf............ **21. D. discocalyx**
Not this combination............ 32

32. Leaves 8–32 × 4–12 cm, with attenuate base and very short petiole (leaves almost subsessile); midrib grooved above and with prominently raised rims alongside the groove, especially towards the petiole................................**22. D. elliptifolia**
Not this combination..33

33. Leaves oblong-elliptic to elliptic, 7–21 × 3–7 cm, with somewhat undulate margins and acute to rounded apex. Trees of seacoasts..........................**45. D. maritima**
Not this combination..34

34. Calyx lobes elongated or filiform, 0.1–0.2 cm wide and 4–15 times as long...35
Calyx unlobed (truncate) or lobed with the lobes not so elongated..............36

35. Calyx lobes glabrous...**18. D. densa**
Calyx lobes covered with spreading rusty hairs..........................**28. D. ferox**

36. Calyx truncate (with neither lobes nor teeth).......................................37
Calyx divided into lobes or teeth..38

37. Leaves 10–20 cm long, with 5–8 pairs of lateral veins......................**73. D. ulo**
Leaves 21–26 cm long, with *c.* 12 pairs of lateral veins............**68. D. subtruncata**

38. Calyx lobes imbricate (overlapping)...39
Calyx lobes (or teeth) valvate (not overlapping).......................................52

39. Leaf base mostly cordate, subcordate or rounded....................................40
Leaf base mostly cuneate or attenuate...46

40. Intercostal venation scalariform..41
Intercostal venation reticulate...42

41. Fruits to 6 cm diameter, on 1–3.5 cm long stalks......................**17. D. daemona**
Fruits to *c.* 2.5 cm diameter, on *c.* 0.5 cm long stalks...**52. D. penibukanensis** (in part)

42. Lateral veins faint on the leaf undersurface......................**5. D. blancoi** (in part)
Lateral veins prominently raised on the leaf undersurface............................43

43. Twigs bearing 0.2–0.3 cm long spreading hairs........................**13. D. cordata**
Twigs bearing short appressed hairs..44

44. Fruits glabrous to sparsely appressed hairy; fruit calyx lobes 0.6 × 0.6 cm.................
....**42. D. lunduensis**
Fruits densely velvety or bearing bristly hairs; fruit calyx lobes to 0.3 × 0.3 cm........
....45

45. Midrib sunken above. Fruits velvety.....................................**27. D. everettii**
Midrib prominent above. Fruits (and ovary) bristly hairy............**47. D. muricata**

46. Male inflorescence (excluding flowers) 2–4.5 cm long...................**15. D. crockerensis**
Male inflorescence (excluding flowers) 0.1–1.5(–3) cm long.........................47

47. Fruit calyx, including the lobes, forming a cup tightly fitting the base of the fruit.............**53. D. perfida** (in part)
Fruit calyx not forming a tightly fitting cup..........48

48. Fruits oblong-ellipsoid..........**56. D. plectosepala**
Fruits globose..........49

49. Fruit calyx lobes up to 0.6 × 0.6 cm..........**10. D. cauliflora**
Fruit calyx lobes up to 0.3 × 0.2 cm..........50

50. Fruits sparsely appressed hairy or glabrous..........**49. D. oligantha**
Fruits densely hairy or velvety..........51

51. Inflorescence (excluding flowers) 0.2–0.5 cm long..........**67. D. subrhomboidea**
Inflorescence (excluding flowers) 0.6–2 cm long..........**63. D. simaloerensis**

52. Calyx divided into 3 (rarely 4) lobes..........53
Calyx divided into 4 or 5 (rarely 3) lobes or teeth..........56

53. Fruits to 5 cm diameter when dried..........**71. D. toposia** (in part)
Fruits to 3 cm diameter when dried..........54

54. Fruit calyx lobes reflexed backwards..........**74. D. venosa**
Fruit calyx lobes not reflexed backwards..........55

55. Fruit calyx forming a shallow 3-pointed dish or cup of about the same diameter as the fruit..........**29. D. ferrea**
Fruit calyx small and dwarfed by the fruit..........**2. D. andamanica**

56. Fruits 2.5 cm diameter or smaller when dried..........57
Fruits 2.5–7.5 cm diameter when dried..........69

57. Fruits asymmetric, one side with a longer curve than the opposite side.............**72. D. tuberculata**
Fruits symmetric (sometimes curved in *D. sumatrana*)..........58

58. Fruits ovoid, ellipsoid, oblong or spindle-shaped..........59
Fruits globose or nearly so..........61

59. Inflorescence (excluding flowers) 1–6.5 cm long..........**33. D. fusiformis**
Inflorescence (excluding flowers) 0.1–0.5 cm long..........60

60. Fruit calyx lobes erect or spreading..........**70. D. sumatrana**
Fruit calyx lobes reflexed..........**39. D. kurzii**

61. Lateral veins prominulous to almost flush with the leaf undersurface..........62
Lateral veins prominent on the leaf undersurface..........63

62. Midrib velvety hairy below............................**30. D. ferruginescens** (in part)
Midrib glabrous below..**54. D. pilosanthera** (in part)

63. Lateral veins 11–30 pairs..64
Lateral veins 4–11 pairs...65

64. Fruit calyx lobes leafy-coriaceous and outstretched...**54. D. pilosanthera** (in part)
Fruit calyx lobes woody and short.......................................**75. D. wallichii**

65. Leaves densely hairy below...66
Leaves glabrous below..67

66. Petioles 0.8–1.2 cm long......................................**40. D. lanceifolia** (in part)
Petioles 0.5–0.7 cm long...................................**30. D. ferruginescens** (in part)

67. Leaves membranaceous..**32. D. frutescens**
Leaves chartaceous to coriaceous..68

68. Fruit calyx veins faint or invisible..........................**40. D. lanceifolia** (in part)
Fruit calyx distinctly veined..**16. D. curranii**

69. Fruit calyx prominently veined..70
Fruit calyx veins very faint or invisible...73

70. Leaves oblong, 15–45 × 6.5–14 cm, coriaceous, drying subglaucous below; intercostal veins forming a very close and prominent reticulation on the leaf undersurface...**60. D. rigida**
Leaves elliptic, ovate, narrowly oblong-elliptic or obovate, up to 22 × 10 cm, chartaceous, not subglaucous below; intercostal veins prominulous below.......71

71. Leaves narrowly oblong-elliptic, up to 15 × 4.3 cm, with lateral veins tending to form intramarginal loops...**14. D. coriacea**
Not this combination...72

72. Petiole and midrib below coarsely wrinkled on drying...........**19. D. dictyoneura**
Petiole and midrib not coarsely wrinkled on drying.................**55. D. piscicarpa**

73. Fruit calyx, including the lobes, shaped into a tight-fitting cup clasping the base of the fruit...**53. D. perfida** (in part)
Fruit calyx (or at least the lobes) not shaped into a tight-fitting cup.............74

74. Leaves oblong-elliptic to oblong-obovate, intercostal venation forming a very fine and prominulous reticulo-scalariform pattern in which the scalariform lines are about 0.2 cm apart...**35. D. hallieri**
Not this combination...75

75. Leaves oblong to oblong-elliptic, with minute reticulations of less than 0.1 cm width on both sides, often bullate between the veins.........................**71. D. toposia** (in part)
Not this combination...76

76. Fruits with 9–16 vertical ribs or furrows, corresponding to the number of seeds developed within……………………………………………………………**1. D. alatella**
Fruits not ribbed……………………………………………………………………77

77. Leaves narrow, 1.5–3 cm wide……………………………**8. D. britanno-borneensis**
Leaves mostly wider than 3 cm…………………………………………………78

78. Basal part of the fruit calyx forming a conspicuous cup fitting the basal quarter to half of the fruit……………………………………………………………………………79
Basal part of the fruit calyx not distinctly cup-like………………………………80

79. Fruits solitary, on 0.2–0.6 cm long stalks………………………**38. D. korthalsiana**
Fruits in clusters of 1–3, on 1–2 cm long stalks………………**66. D. styraciformis**

80. Fruit calyx lobes to 0.5 × 0.5 cm, flattened against the base of the fruit…**61. D. rufa**
Fruit calyx lobes not so…………………………………………………………81

81. Fruit calyx lobes *c.* 1 cm long and with the two sides of each lobe folded back to almost meet each other……………………………………………………………**69. D. sulcata**
Fruit calyx lobes not so…………………………………………………………82

82. Fruits densely velvety, conspicously puckered on drying………**58. D. pyrrhocarpa**
Fruits glabrous to velvety, not puckered on drying………………………………83

83. Fruits up to 3.5 cm diameter; fruit calyx lobes usually much folded (plicate)………… ……………………………………………………………**54. D. pilosanthera** (in part)
Fruits 4–7.5 cm diameter; fruit calyx lobes less plicate…………………………84

84. Leaves densely to sparsely hairy on the midrib and lateral veins below……………… ……………………………………………………………………**43. D. macrophylla**
Leaves glabrous……………………………………………………………………85

85. Leaf uppersurface smooth and shiny……………………………………**3. D. areolata**
Leaf uppersurface dull……………………………………………………………86

86. Fruit calyx forming a flat 4–5-pointed woody plate, not as wide as the fruit, with the edges of the lobes stretched until no longer evident or persisting as a narrow reflexed fringe……………………………………………………………**59. D. ridleyi**
Fruit calyx very variable, erect or reflexed, with the base of the calyx tube greatly thickened or not, and the lobes greatly expanded or not, often wider than the fruit ……………………………………………………………………**46. D. mindanaensis**

1. **Diospyros alatella** Kosterm. Fig. 2C.

(Latin, *alatellus* = furnished with small wing/expansion; referring to the fruit)

Blumea 23 (1977) 451. **Type:** *Ashton S 18083*, Borneo, Sarawak, Bintulu district, Ulu Saran, Labang (holotype L; isotypes FHO, K, SAR, SING).

Tree to 33 m tall. **Twigs** velvety when young, terminating in large velvety-hairy buds, becoming glabrous with age. **Leaves** chartaceous, *glabrous*, *not subglaucous below*; *oblong*, *28–37 × 9–13 cm*, *base cuneate*, *margin not undulate*, *apex acute* to *acuminate*; *midrib sunken above*; *lateral veins prominent below*, *to 15 pairs*, *inarching and joining to form intramarginal vein-loops at a distance from leaf margin*; *intercostal venation prominulous on both sides*, *laxly reticulate*; *petiole 1.5–2 cm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** *c.* 0.3 cm long, *arising on thick branches of c. 1.3 cm diameter*, each bearing solitary flower. **Female flowers** with *calyx deeply divided into 5–6 valvate ovate lobes*. **Fruits** solitary, on *c.* 0.3 cm stalks, densely velvety when young, depressed ovoid-globose, to *c. 4.5 cm diameter*, *deeply 9–16-ribbed corresponding to the number of seeds developed within*, glabrous. **Fruit calyx** *accrescent*; *lobes coriaceous*, *plicate*, velvety, *c.* 3 × 2.5 cm, *at first erect*, *then spreading*; *veins very faint to invisible*.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 13968* from the Semengoh Arboretum and *S 18083* from Bintulu).

Ecology. In lowland mixed dipterocarp to lower montane forest, to 1200 m altitude.

Notes. The combination of large leaves and large ribbed fruits is diagnostic. *D. sulcata* also has large leaves and ribbed fruits but the two sides of each lobe are bent back-to-back.

2. **Diospyros andamanica** (Kurz) Bakh.

(of the Andamans)

Bull. Jard. Bot. Buitenz. 3, 15 (1937) 74, 382; Ng *l.c.* (1977) 211, *l.c.* (1978) 61; Turner *l.c.* 196; Ng, Gard. Bull. Sing. 53 (2001) 309; Beaman *et al. l.c.* 226. **Basionym:** *Macreightia andamanica* Kurz, Rep. Veg. Andam. 2 (1870) 42. **Syntypes:** *Novara 148* and *Jelinek 105*, Andamans (*n.v.*). **Synonyms:** *Maba andamanica* (Kurz) Kurz, J. As. Soc. Beng. 45, 2 (1876) 138, For. Fl. Brit. Burma 2 (1877) 140; *Maba carpinifolia* Ridl., Kew Bull. Misc. Inf. 2 (1926) 73; *D. carpinifolia* (Ridl.) Bakh. *l.c.* (1933) 162, *l.c.* (1937) 72; *D. malayana* Bakh. *l.c.* (1933) 163, *l.c.* (1937) 75; *D. tahanensis* Bakh. *l.c.* (1933) 163, *l.c.* (1937) 69, Ng *l.c.* (1978) 89, Anderson *l.c.* 169; *D. longepedunculata* Kosterm. *l.c.* 462; *Maba punctata* Hiern *l.c.* 136, Merrill *l.c.* (1921) 483, *l.c.* (1929) 240, Masamune *l.c.* 607.

Tree to 20 m tall. **Twigs** densely velvety to glabrous, rusty brown or blackish. **Leaves** chartaceous, velvety hairy to glabrous on veins and *not subglaucous below*; *oblong-elliptic*, *elliptic* or *ovate*, *7–27 × 2.5–10.5 cm* (with a narrow-leafed riverine form 12.5–21 × 1.4–3.7 cm), *base cuneate*, rounded or subcordate, *margin not undulate*, *apex acuminate*; *midrib sunken above*, groove often filled with hairs; *lateral veins 7–10 pairs*, *prominent below*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *laxly scalariform* (reticulate in the narrow-leafed forms); *petiole 0.2–1 cm long*. **Male inflorescences** *0.3–1.5 cm long*, each bearing 6–30 or more flowers. **Male flowers** with *calyx divided a quarter or a third down into 3 valvate triangular lobes*; corolla salverform, 0.5–0.9 cm long. **Female inflorescences** *0.5–2.5 cm long*, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 3* (*rarely 4*) *triangular valvate lobes*. **Fruits** 1–3 or more, on 0.5–1.5 cm long stalks, *globose*, ovoid or ellipsoid, *1.5–3 cm diameter*, *with slightly to prominently pimpled surface*, *densely hairy.* **Fruit calyx** *not accrescent*, *remaining small and 3-lobed*; *lobes not reflexed backwards*, *to 0.3 × 0.2 cm*.

Distribution. Andamans, Sumatra, Peninsular Malaysia, and Borneo. In Borneo common, known from Sabah (e.g., *Elmer 20098*, *SAN 25812*, *SAN 30083*, *SAN 100329*, and *SAN 134545*), Sarawak (e.g., *S 13601*, *S 21351*, *S 50106*, and *S 63182*) and Kalimantan (e.g., *Kessler 1866*, *Kostermans 2645*, *Kuswata 852*, and *Mogea 3540*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Notes. This species has numerous synonyms and is very often misidentified. The variation in leaf size and shape is great but the scalariform intercostal venation, the calyx (both male and female) divided into three valvate lobes, and the pimply-surfaced fruit with small (non-accrescent) valvate calyx are diagnostic. Glabrous specimens from Peninsular Malaysia were previously kept separate as *D. tahanensis* Bakh., but with the examination of more specimens, the separation cannot be justified. The intercostal venation is reticulate close to the midrib but scalariform towards the margins; that of narrow-leafed forms tend to be reticulate. The extreme narrow-leafed riverine form may be mistaken for *D. eucalyptifolia* or *D. lanceifolia* var. *saliciformis.*

3. **Diospyros areolata** King & Gamble Fig. 4K.

(Latin, *areolatus* = net-like; referring to the intercostal venation)

J. As. Soc. Beng. 74, 2 (1906) 228; Bakhuizen *l.c.* (1938) 365; Ng *l.c.* (1977) 212, *l.c.* (1978) 63; Turner *l.c.* 196; Ng *l.c.* (2001) 309. **Syntypes:** *King's Collector 5813* (K, SING) and *Scortechini 476* (K), Peninsular Malaysia, Perak. **Synonyms:** *D. bantamensis* Koord. & Valeton *ex* Bakh. *l.c.* (1933) 165, *l.c.* (1938) 322, Anderson *l.c.* 167, Argent *et al.* (eds.) *l.c.* 178; *D. malam* Bakh. *l.c.* (1933) 176, *l.c.* (1938) 324, Masamune *l.c.* 604; *D. pseudomalabarica* Bakh. *l.c.* (1933) 182, Anderson *l.c.* 170, Coode *et al.* (eds.) *l.c.* 89.

Tree to 30 m tall. **Twigs** reddish tomentose when young, becoming glabrous with age. **Leaves** coriaceous, *glabrous*, *often drying with a yellow tinge*, *upper surface smooth and shiny*; *ovate*, *elliptic*, or *oblong*, *8–16*(*–26*) × *3–6*(*–9*) *cm*, *base broadly cuneate* to rounded, *margin not undulate*, apex acuminate; *midrib prominent*, *shallowly impressed* or *sunken above*; *lateral veins* prominent below, (*3–*)*4–8 pairs*, *with a tendency to form intramarginal vein-loops near leaf margin*; *intercostal venation prominent below*, *areolate*; *petiole 0.8–1.5 cm long*. **Male inflorescences** *0.5–1 cm long*, each bearing usually 3 flowers, sometimes grouped on 5–6 cm long pseudo-racemes formed by the suppression of leaves on a flowering shoot. **Male flowers** with *calyx* densely velvety, *divided into 4 triangular valvate lobes*; corolla cylindric, about 0.8 cm long, divided at the tip into four teeth. **Female inflorescences** *0.2–0.8 cm long*, each usually bearing solitary flower. **Female flowers** with calyx densely velvety, *divided into 4 valvate*, broadly triangular-auriculate erect lobes. **Fruits** solitary, on 0.2–0.8 cm long stalks, *globose*, to *c. 4 cm diameter*, woody, *velvety when young*, *not puckered* or *ribbed on drying*. **Fruit calyx** densely velvety, moderately accrescent, woody, *forming a shallow 4-pointed plate*; *veins invisible*.

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, known from Sabah (e.g., *SAN 22954*, *SAN 30142*, *SAN 61478*, *SAN 90903*, and *SAN 141376*), Sarawak (e.g., *S 5051*, *S 9032*, *S 11935*, *S 16663*, and *S 30561*), Brunei (e.g., *Coode 6944*), and Kalimantan (e.g., *bb. 6335*, *bb. 8037*, *bb. 18170*, *Kuswata 1418*, and *Meijer 2194*).

Ecology. Common in lowland mixed dipterocarp and freshwater swamp forests.

Notes. The swamp form tends to have ovate leaves, while the dryland form tends to have oblong leaves. In Peninsular Malaysia, the oblong leafed form predominates. *D. areolata* can be distinguished from *D. brittano-borneensis* by its broader leaves, and from *D. ridleyi* by its shiny (not dull) leaf uppersurface.

4. **Diospyros beccarioides** Ng Fig. 1A–B.

(resembling *Diospyros beccarii* Hiern)

Gard. Bull. Sing. 53 (2001) 291. **Type:** *Yii et al. S 50325*, Borneo, Sarawak (holotype KEP; isotype SAR).

Tree to 20 m tall. **Twigs** densely reddish brown pubescent, becoming glabrous with age. **Leaves** *membranaceous* to *chartaceous*, *glabrous*; *oblong* or *oblong-obovate*, 16–30 × 5.5–11 cm, base cuneate and slightly attenuate, rarely rounded, apex acuminate; midrib above sunken, flat, or sunken with raised sides; *lateral veins* prominent below, 7–13 pairs, *inarching and joining to form a more-or-less distinct intramarginal vein close to leaf margin*; *intercostal venation prominulous below*, *laxly scalariform*; petiole 0.8–1.5 cm long. **Male inflorescences** subsessile condensed cymes of 3 or more flowers. **Flowers** unknown. **Fruits** 1–3, on 0.3–0.8 cm long stalks, depressed globose, to *c*. 2.5 cm diameter, glabrous, smooth to slightly puckered. **Fruit calyx** *accrescent*, *divided into 4–5 valvate lobes*; lobes erect, leafy-coriaceous, plicate, to *c*. 2 × 1.5 cm.

Distribution. Sumatra, Borneo, and Sulawesi. In Borneo, known from Sarawak (*S 8633*, *S 16177*, *S 31817*, *S 32625*, *S 50325*, *S 65187*, *Chew CWL 1100*, and *Chew CWL 1141*) and Kalimantan (*Endert 5164*, *Endert 5380*, *Kessler et al. 824*, and *Kessler et al. 969*).

Ecology. In Sarawak, the species is known from limestone hills in the lowlands, to 200 m altitude.

Notes. Bakhuizen (*l.c.* (1938) 239) had three species mixed up under his '*D. beccarii*'. The two syntypes of *D. beccarii* Hiern belong to *D. sumatrana* (hence *D. beccarii* has to be reduced to *D. sumatrana*). At least two others of his cited specimens, *bb. 12051* and *bb. 14750*, belong to *D. daemona*. The third element, represented by e.g. *Endert 5164* represents a new species, *D. beccarioides*, which can be distinguished from *D. sumatrana* by its larger fruits with accrescent calyx lobes up to 2 cm long, and larger leaves, with a stronger tendency to form intramarginal veins.

5. **Diospyros blancoi** A.DC.

(F.M. Blanco, 1778?–1845, Spanish priest and botanist in the Philippines)

Prod. 8 (1844) 237; PROSEA 2 (1991) 151; Ng *l.c.* (2001) 309. **Type:** unknown. **Synonyms:** *D. discolor* Willd., Sp. Pl. 4 (1805) 1108, *nom. illeg.*, Merrill *l.c.* (1921) 484, Bakhuizen *l.c.* (1937) 145, Masamune *l.c.* 602, Ng *l.c.* (1978) 70; *D. durionoides* Bakh. *l.c.* (1933) 169, *l.c.* (1937) 133, Masamune *l.c.* 602, Argent *et al.* (eds.) *l.c.* 182; *D. argentea auct. non* Griff.: Anderson *l.c.* 167; *D. celebica auct. non* Bakh.: Anderson *l.c.* 167.

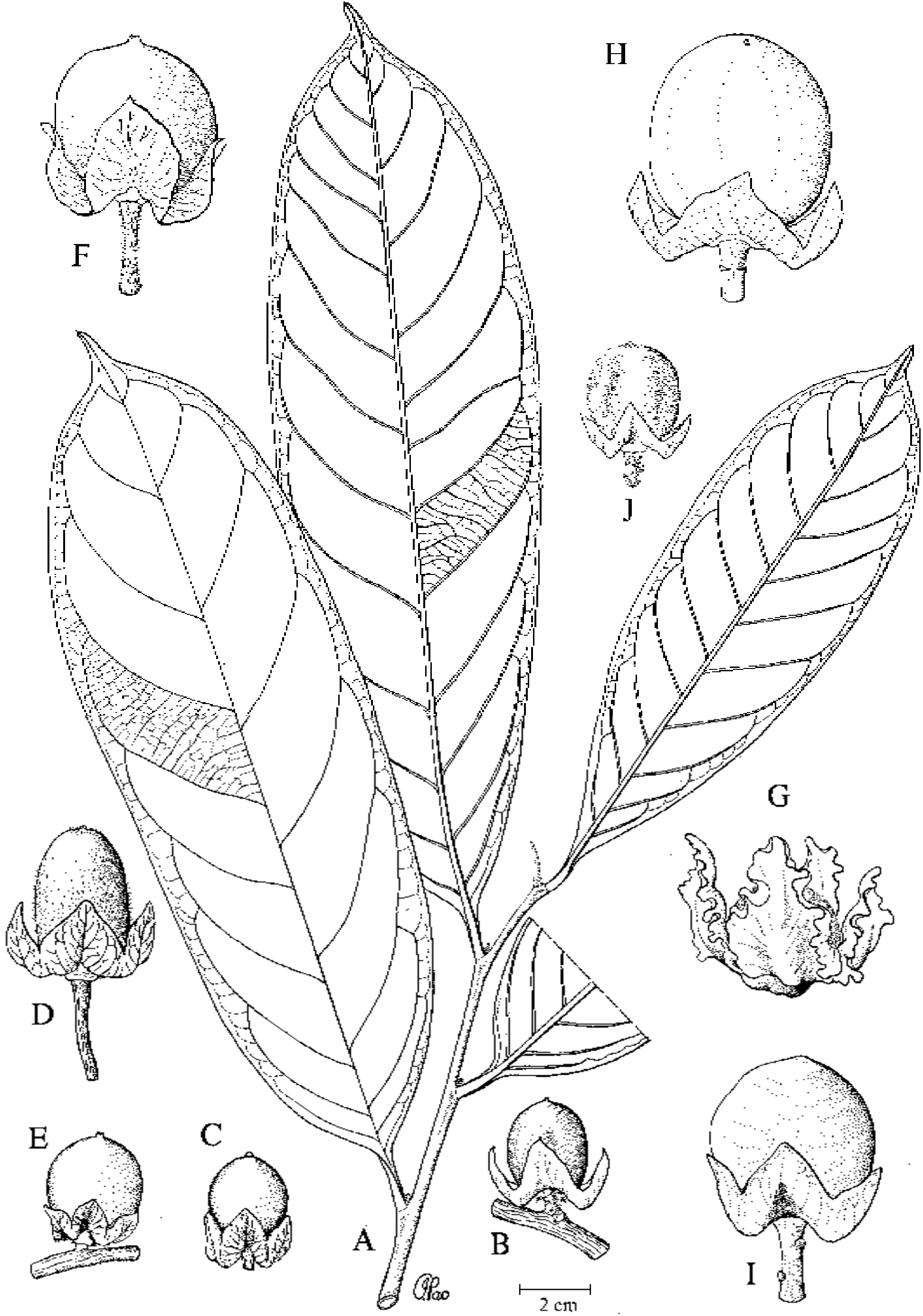

Fig. 1. *Diospyros beccarioides* (A–B); *D. coriacea* (C); *D. dictyoneura* (D); *D. elliptifolia* (E); *D. neurosepala* (F); *D. pilosanthera* var. *elmeri* (G); *D. piscicarpa* (H); *D. rigida* (I); *D. tuberculata* (J). A, leafy twig; B–J, fruits. (A–B from *Chew CWL 1100*, C from *Hallier 1318*, D from *S 38428*, E from *SAN 64571*, F from *Church & Mahyar 1654*, G from *SAN 77815*, H from *Chin 2694*, I from *FRI 19275*, J from *SAN 84954*.)

Tree to 36 m tall. **Twigs** *appressed hairy when young*, becoming glabrous with age, growing and flowering in flushes; basal leaves reduced to scales which are closely spaced. **Leaves** *coriaceous*, *drying not black on both sides*, *without yellowish tinge*, *not glaucous below*, *young leaves densely appressed silky-hairy below*, usually maturing glabrous; *oblong* to *oblong-obovate*, *11–30 × 3.5–8 cm*, *base rounded* to *subcordate*, *rarely cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins faint below*, *8–10 pairs*, *inarching and joining to form faint intramarginal vein-loops* or *arching and diminishing near leaf margin*; *intercostal venation invisible* or *faint and finely reticulate below*; *petiole 0.5–1 cm long*. **Male inflorescences** *c.* 0.2 cm long, each bearing 3–5 crowded flowers. **Male flowers** with *calyx divided more than halfway into 4 oblong-ovate imbricate lobes*; corolla *c.* 1 cm long, salverform. **Female inflorescences** 0.1–0.3 cm long, each bearing solitary flower. **Female flowers** *with calyx divided almost to base into 4 rounded imbricate lobes*. **Fruit** solitary, *subsessile*, *on 0.1–0.3 cm stalks*, *globose*, *depressed-globose* or *oblong*, *to 4 cm diameter* (but fruits of cultivated trees *to 5 cm diameter* or larger), *densely velvety*, *puckered when dry*. **Fruit calyx** not or only slightly accrescent; *lobes 0.3–1.5 × 0.3–1 cm*.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *FMS 44581*, *SAN 9407*, *SAN 27040*, *SAN 27554*, *SAN 49996*, and *SAN 63683*), Sarawak (e.g., *S 14606*, *S 23748*, *S 27988*, *S 28092*, *S 32142*, *S 32665*, *S 40027*, *S 45293*, and *Chew CWL 673*) and Kalimantan (e.g., *bb. 7978*, *bb. 10050*, *bb. 12456*, *bb. 18922*, *bb. 19038*, *bb. 19070*, *Kostermans 4874*, and *Kostermans 13929*).

Ecology. In lowland mixed dipterocarp, limestone and coastal forests.

Notes. *D. blancoi* is widely cultivated in the Philippines for its edible fruits and wood (used in handicrafts) and as an ornamental tree. It is sproradically cultivated in Borneo and the rest of SE Asia. Among the wild types in the forests of Borneo and the Philippines (Palawan), some closely match the cultivated forms while others (e.g., "*D. durionoides*") have leaves and fruits distinctly smaller, but there are intermediate forms which smoothly link up the extremes. Anderson misidentified *S 23748* as *D. argentea*, and *S 27988* and *S 28092* as *D. celebica*. Neither of these occur in Borneo. *D. argentea* (a forest tree with edible fruits, restricted to Peninsular Malaysia) differs in the calyx being much larger.

6. **Diospyros borneensis** Hiern
(of Borneo)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 173; Merrill *l.c.* (1921) 484; Fischer, Kew Bull. (1932) 293; Bakhuizen *l.c.* (1938) 314; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Turner *l.c.* 197; Coode *et al.* (eds.) *l.c.* 87 (including *D. cf. borneensis*); Argent *et al.* (eds.) *l.c.* 178. **Type:** *Motley 7*, Borneo, Sarawak (K). **Synonym:** *D. tawaensis* Merr. *l.c.* (1929) 244, Masamune *l.c.* 606.

Tree to 20 m tall. **Twigs** densely reddish brown tomentose when young, becoming glabrous with age, tending to dry black. **Leaves** chartaceous to coriaceous, *glabrous*, tending to dry black on both sides; *oblong*, *elliptic*, or *ovate*, 11–30 × 4–12.5 cm, base cuneate or rounded, apex acuminate; midrib sunken above; *lateral veins* prominent below, 8–14 pairs, tending to dry blacker than the rest of the leaf, *joining to form an intramarginal vein very close to leaf margin*; *intercostal venation prominulous* to *prominent below*, *scalariform*; petiole 0.8–2 cm long. **Male inflorescences** condensed cymes 0.5–1 cm long, each bearing 3–20 or more flowers, the size of the clusters increasing with the size of the branches on which they are borne. **Male flowers** with *calyx shaped like a cone with truncate top*, *c.* 0.7 cm long; corolla *c.* 1.5 cm long, salverform. **Female inflorescences** 0.5–1.5(–2.5) cm long, each bearing usually solitary flower. **Female flowers** with *calyx in the form of a truncate cup* of *c. 1 × 1 cm*, often split into two parts, and split further as the fruit develops. **Fruits** usually solitary, on 0.5–1.5(–2.5) cm long stalks, globose, to *c.* 4.2 cm diameter, often vertically split on drying, drying black, glabrous. **Fruit calyx** not accrescent, *c.* 2 cm wide, split irregularly and flattened, or slightly reflexed.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 16465*, *SAN 30534*, *SAN 62444*, *SAN 87635*, and *SAN 108010*), Sarawak (e.g., *Pennington 7964*, *S 30698*, *S 40519*, *S 43856*, and *S 66240*), Brunei (e.g., *BRUN 871*, *Coode 6753*, *Dransfield JD 6900*, *Niga 210*, and *SAN 17420*), and Kalimantan (e.g., *Arifin & Ambriansyah 1013*, *Jarvie & Ruskandi 5636*, and *Kostermans 10675*).

Ecology. Common in lowland, hill mixed dipterocarp and lower montane forests, to 1000 m altitude.

Notes. Easy to recognise by the intramarginal veins running close to the leaf margins, the scalariform intercostal venation, and the tendency of the leaves and especially the veins, to dry black. However, in Sarawak, two specimens (*S 32307* and *S 30698*) diverge from the norm in not forming an intramarginal veins and also their intercostal venation is less scalariform.

7. **Diospyros brainiana** Ng Fig. 2A–B.

(Brain anak Tada, plant collector of the Sarawak Forest Department 1961–1970)

Gard. Bull. Sing. 53 (2001) 292. **Type:** *Brain anak Tada S 15932*, Borneo, Sarawak (holotype SAR; isotypes SAN, SING).

Tree to 29 m tall. **Leaves** chartaceous, *glabrous*; narrowly oblong-obovate, 11.5–19.5 × 2.5–6 cm, base cuneate, apex acuminate; midrib sunken above; *lateral veins* prominulous to prominent below, *flush* or *prominulous above*, 8–13 pairs, *inarching and joining to form intramarginal vein at about one third of the distance from margin to midrib*; *intercostal venation faint*, *reticulate*; *petiole 1–1.5 cm long*. **Male and female inflorescences** and **flowers** unknown. **Fruits** solitary, *subsessile*, depressed globose with sunken top, to 4.5 cm diameter, drying shallowly lobed or ridged, glabrous. **Fruit calyx** accrescent, divided deeply into 4–5 velvety, leafy coriaceous, *faintly veined valvate lobes c. 1.5 cm long*; *main axis of each lobe curved upwards following the curvature of the fruit base*, *but the sides bend backwards towards each other.*

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 15932* and *S 27961*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The location of the intramarginal vein at some distance from the margin reminds of *D. neurosepala*, which differs in having leafy calyx lobes. The fruit calyx reminds that of *D. sulcata*, which differs in the lack of an intramarginal vein in the leaves.

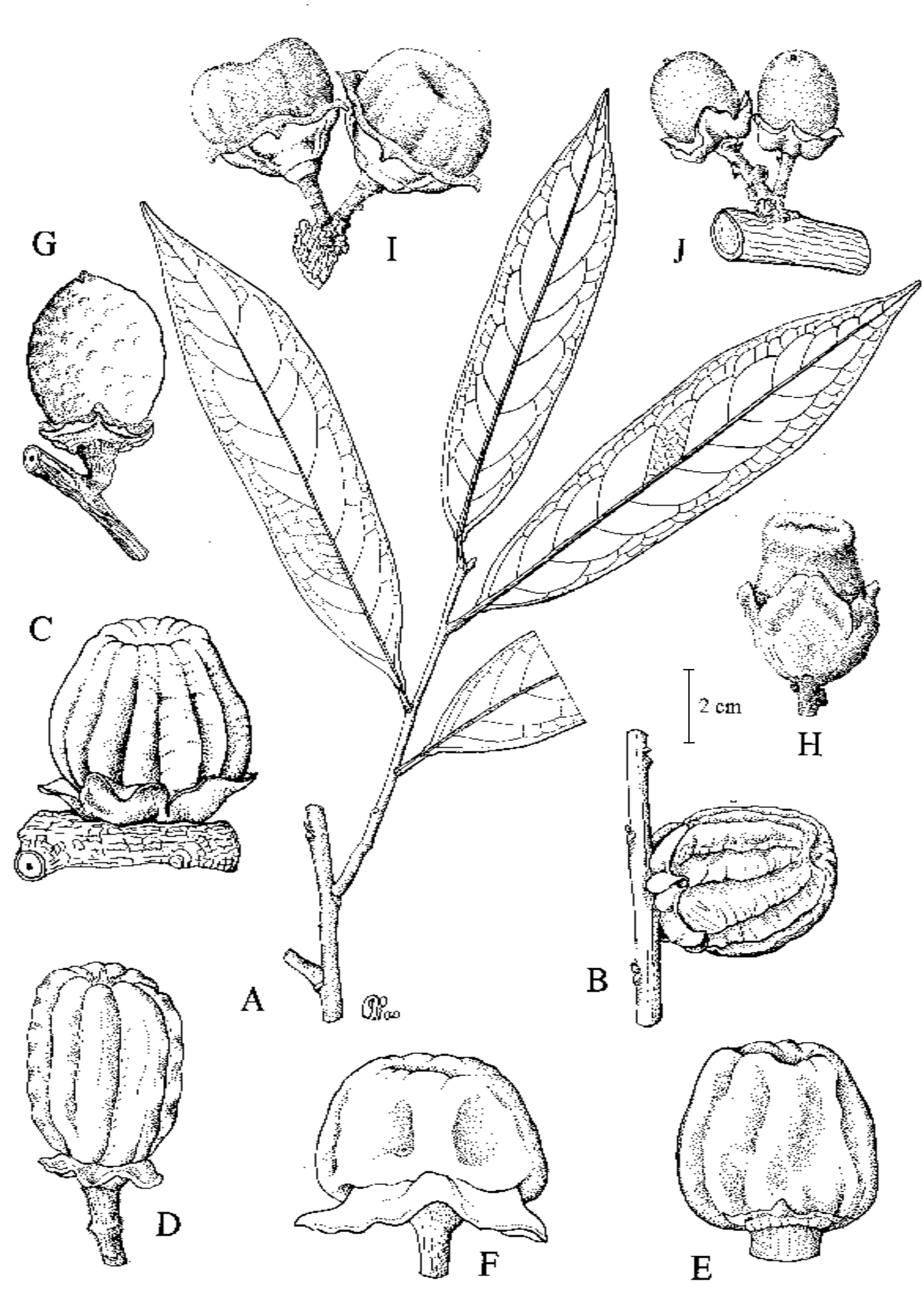

Fig. 2. *Diospyros brainiana* (A–B); *D. alatella* (C); *D. foxworthyi* (D); *D. hallieri* (E); *D. macrophylla* (F); *D. ridleyi* (G); *D. siamang* (H); *D. styraciformis* (I); *D. wallichii* (J). A, leafy twig; B–J, fruits. (A–B from *S 15932*, C from *S 13968*, D from *S 43584*, E from *SAN 69454*, F from *S 32171*, G from *S 28024*, H from *FRI 2069*, I from *S 54204*, J from *S 49198*.)

8. **Diospyros britanno-borneensis** Bakh.

(of British Borneo = Sabah)

Bull. Jard. Bot. Buitenz. 3, 15 (1938) 333; Anderson *l.c.* 167; Beaman *et al. l.c.* 226. **Type:** *Clemens 31934*, Borneo, Sabah (holotype BO; isotypes KEP, L).

Tree to 30 m tall. **Twigs** terete, *sparsely lenticellate*, *drying greyish* or *blackish*. **Leaves** coriaceous, *not bullate between veins*, *glabrous*, *not glaucous beneath*; *narrowly oblong-elliptic*, *6–13 × 1.5–3 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken* to *flat above*; *lateral veins prominent below*, 6–10 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *finely reticulate*; *petiole 0.5–1 cm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** 0.8–2 cm long, each bearing solitary flower. **Female flowers** with *calyx divided into 4 or 5 broadly triangular valvate lobes*. **Fruits** *solitary*, *on 0.4–2 cm long stalks*, *ovoid* to *globose*, to *5.5 cm diameter*, *smooth and glabrous*. **Fruit calyx** *accrescent*; *lobes 4–5*, *valvate*, *thin*, *brittle*, *unveined*, *erect* or *reflexed*, *up to 2 cm long*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *Chew et al. 1851* and *Clemens 31935*) and Sarawak (e.g., *S 12608*, *S 13176*, *S 34446*, *S 35469*, *S 37925*, *S 37930*, *S 45052*, and *S 59214*).

Ecology. In hill mixed dipterocarp to mossy montane forests, at 630–2000 m altitude.

Notes. The fruit calyx is apparently erect at first, then spreading and finally reflexed as the fruit grows. *D. britanno-borneensis* is distinguished from *D. coriacea* by the long fruit stalk (0.8–2 cm), the calyx lobes unveined and non-plicate, and the absence of intramarginal veins in the leaves. It can be distinguished from *D. areolata* by its narrower leaves and cuneate leaf base.

9. **Diospyros buxifolia** (Blume) Hiern Fig. 6C.

(Latin, *buxifolius* = with leaves resembling those of *Buxus*)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 218; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1937) 97; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Coode *et al.* (eds.) *l.c.* 88 (including *D. cf. buxifolia*); Argent *et al.* (eds.) *l.c.* 179; Ng *l.c.* (2001) 309; Beaman *et al. l.c.* 227. **Basionym:** *Leucoxylum buxifolium* Blume, Bijdr. Fl. Ned. Ind. (1825) 1169. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *D. elegantissima* Bakh. *l.c.* (1933) 169, *l.c.* (1937) 103, Ng *l.c.* (1978) 70.

Tree to 20 m, rarely to 30 m tall. **Twigs** velvety when young, glabrescent, *not tending to dry black*. **Leaves** chartaceous, *dull greenish* and glabrous to hairy *below*; *rhombic-elliptic* (*with 4 opposite sides parallel to each other*) or *ovate*, *1.3–5(–6) × 0.5–2.2 cm*, *base cuneate*, apex acute to acuminate; midrib above prominulous and hairy; lateral veins faint, arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole *c.* 0.1 cm long. **Male inflorescences** 0.1–0.5 cm long, *each bearing 2–5 clustered tiny flowers*. **Male flowers** *ovoid or globose in bud*, *c. 0.2 cm long*; calyx hairy, divided almost to base into 4 imbricate ovate lobes; corolla to *c.* 0.2 cm long, ovoid or globose. **Female inflorescences** *0.1–0.2 cm long*, each bearing tiny solitary flower. **Female flowers** with calyx hairy, divided almost to base into 4 imbricate ovate lobes. **Fruits** solitary, *subsessile*, *on 0.1–0.2 cm long stalks*, *ellipsoid*, to *c.* 1.6 × 1 cm. **Fruit calyx** not accrescent; lobes *c.* 0.1 × 0.2 cm.

Distribution. India and Sri Lanka to Indo-China and Malesia as far as New Guinea. In Borneo, known from Sabah (common, e.g., *SAN 22240*, *SAN 54042*, *SAN 71535*, *SAN 97953*, and *SAN 138855*), Sarawak (e.g., *S 6859*, *S 45910* and *SFN 10255*), Brunei (e.g., *BRUN 293*, *BRUN 299*, *Coode 6753*, and *S 5567*), and Kalimantan (e.g., *Burley et al. 2364*).

Ecology. In lowland, hill mixed dipterocarp and lower montane forests, to 1000 m altitude.

Notes. *D. elegantissima* of Peninsular Malaysia, previously considered distinct because of its very small leaves, is bridged smoothly to *D. buxifolia* by intermediate specimens and does not deserve to be recognised as a separate species. *D. buxifolia* differs from *D. squamaefolia* and the rhombic-leafed form of *D. graciliflora* by the cuneate, rarely acuminate, leaf base. Other differences are that in *D. squamaefolia* and *D. graciliflora*, corolla of the male flowers are salverform and the fruits globose. *D. parabuxifolia* differs by its long, 1.5–2 cm fruit stalks.

10. **Diospyros cauliflora** Blume

(Latin, *cauliflorus* = flowering on the tree trunk)

Bijdr. Fl. Ned. Ind. (1825) 668; Fischer *l.c.* 293; Bakhuizen *l.c.* (1937) 134; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Turner *l.c.* 197; Argent *et al.* (eds.) *l.c.* 179; Beaman *et al. l.c.* 227. **Type:** *Blume s.n.*, Java, G. Parang (holotype L; isotype BO). **Synonyms:** *D. pergamena* Hiern *l.c.* 243, Merrill *l.c.* (1921) 485, Masamune *l.c.* 605; *D. fasciculiflora* Merr., Philip. J. Sci. 9 (1914) 334, *l.c.* (1929) 241 (including var. *pubinervia* Merr.), Masamune *l.c.* 603.

Tree to 17 m tall; trunk with swollen callus-like knobs from which inflorescences appear. **Twigs** reddish brown pubescent, becoming glabrous with age. **Leaves** membranaceous, *not glaucous* and glabrous to finely velvety *below*; *obovate*, *10–40 × 3–13 cm*, *base cuneate*, rarely rounded, *margin not undulate*, *apex acuminate*; *midrib shallowly depressed above*, *sunken* or *flush* with blade surface; *lateral veins prominent below*, *5–14 pairs*, usually *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *reticulate* to *laxly scalariform*; *petiole 0.6–1.5 cm long*. **Inflorescences** borne on twigs, branches or trunk. **Male inflorescences** *0.2–1.2 cm long*, each bearing several to numerous tiny flowers. **Male flowers** with *calyx divided into* (*3–*)*4*(*–5*) *imbricate ovate lobes*; corolla less than 0.2 cm long, ovoid in bud. **Female inflorescences** *c. 0.5 cm long*, each bearing several to numerous flowers. **Female flowers** with *calyx divided almost to base into* (*3–*)*4* (*–5*) *imbricate lobes*. **Fruits** on *c.* 0.5 cm long stalks, on twigs, branches or trunk, *globose*, to *c. 2.5 cm diameter*, usually beaked at apex, *smooth* to *broadly lobed with as many lobes as seeds contained within*, up to a maximum of 4 seeds only. **Fruit calyx** accrescent; *lobes up to c. 0.6 × 0.6 cm*, thickened, reflexed, velvety, *not forming a tightly fitting cup*.

Distribution. Thailand and throughout Malesia. In Borneo, known from Sabah (e.g., *Kokawa & Hotta 2303*, *SAN 22227*, *SAN 65191*, *SAN 96345*, and *SAN 133326*), Sarawak (e.g., *S 12298*, *S 20260*, *S 38989*, and *S 54089*), and Kalimantan (e.g., *Burley et al. 2349*, *Church et al. 446*, *Kostermans 13760*, and *Mahyar et al. 1325*).

Ecology. Common in lowland mixed dipterocarp and limestone hill forests, to 500 m altitude.

Notes. Although cauliflorous specimens dominate, flowers and fruits may also be borne on the twigs and branches. The species is easily recognised by the obovate membranaceous leaves and the strong tendency towards cauliflory. The minuteness of the male flower buds and the small 1–4-seeded fruits with thick velvety reflexed calyx lobes, are highly distinctive. In Sintang, Kalimantan, there are trees in which the female inflorescences and fruit stalks are exceptionally long: 1–1.5 cm (*Church et al. 392* and *Mahyar et al. 1325*).

11. **Diospyros clementium** Bakh.

(J. Clemens and M.S. Clemens, American husband-and-wife team who collected plants in Borneo in the early half of the 20th Century)

Gard. Bull. S. S. 7 (1933) 167, *l.c.* (1937) 104; Anderson *l.c.* 168. **Type:** *Clemens 20098*, Borneo, Sarawak, G. Pueh (holotype BO; isotype SAR).

Tree to 9 m tall. **Twigs** *bearing 0.2 cm long spreading hairs*. **Leaves** membranaceous, hairy below, *drying olive-green* or *brown*; *oblong*, *parallel-sided*, *1.5–4 × 0.5–1 cm*, base rounded, margin ciliate, apex acute; midrib sunken above, groove filled with hairs, hairy below; lateral veins faint, 10–20 pairs, closely spaced, inarching and joining to form intramarginal vein-loops at some distance from leaf margin; *intercostal venation invisible*; petiole 0.1–0.2 cm long. **Male inflorescences** and **male flowers** unknown. **Female inflorescences** consisting of a solitary flower on a *c.* 0.2 cm stalk. **Female flowers** with calyx divided almost to base into 4 (imbricate?) triangular lobes, each lobe *c.* 0.2 × 0.1 cm; corolla unknown; ovary covered with long bristly hairs. **Fruits** solitary, bristly hairy, on *c.* 0.2 cm long stalks, ellipsoid, *c.* 0.8 × 0.6 cm (immature), symmetric. **Fruit calyx** non-accrescent; lobes *c.* 0.2 × 0.1 cm.

Distribution. Endemic to Borneo and known from Sarawak (e.g., *Clemens 20098*, *Ding Hou 566*, *S 24924*, *S 25124*, and *Sinclair & Kadim 10293*), Brunei (e.g., *Tan et al. 511*), and Kalimantan (e.g., *Church et al. 3264*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m.

Notes. Sterile specimens are superficially close to small-leafed forms of *D. confertiflora*, but may be distinguished by the spreading hairs on the twigs.

12. **Diospyros confertiflora** (Hiern) Bakh.

(Latin, *confertiflorus* = with crowded flowers)

Gard. Bull. S. S. 7 (1933) 162, *l.c.* (1937) 82; Ng *l.c.* (1978) 65; Anderson *l.c.* 168; Turner *l.c.* 197; Coode *et al.* (eds.) *l.c.* 88; Argent *et al.* (eds.) *l.c.* 179. **Basionym:** *Maba confertiflora* Hiern *l.c.* 136, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Motley 205*, Borneo, Sabah, Labuan (K).

Tree to 20 m tall. **Twigs** *glabrous* or *bearing short* (less than 0.1 cm) *hairs*, *tending to dry black*. **Leaves** *membranaceous* to chartaceous, glabrous, or bearing short (less than 0.1 cm long) hairs, *tending to dry black above and sometimes on both sides*; *lanceolate* or *oblong*, *parallel-sided* except where the blade tapered to base and apex, *2.5–9 × 1–5 cm*, base cuneate to rounded, *apex acuminate*; midrib sunken above but groove sometimes filled with small hairs; lateral veins prominulous, *c.* 6 pairs, arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole 0.2–0.5 cm long. **Male inflorescences** 0.1–0.4 cm long, each bearing 3–12 tiny flowers. **Male flowers** with calyx *c.* 0.1 cm long, divided into 3 triangular valvate lobes; corolla ellipsoid to oblong in bud, 0.2–0.4 cm long. **Female inflorescences** 0.2–0.3 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 3 imbricate lobes. **Fruits** solitary, on 0.2–0.3 cm long stalks, ovoid but markedly asymmetric, with one side more strongly curved than the other, so that the pointed apex is shifted off-centre, to 2.2 × 1.3 cm, smooth and glabrous. **Fruit calyx** leafy coriaceous; lobes *c.* 0.5 × 0.5 cm, completely reflexed backwards.

Vernacular name. Sarawak—*kayu malam pinang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 41327*, *SAN 103355*, *SAN 127091*, and *SAN 132102*), Sarawak (e.g., *S 13351*, *S 24143*, *S 30042*, *S 44718*, and *S 73355*), Brunei (e.g., *BRUN 15030*), and Kalimantan (e.g., *Ambriansyah 2025*, *van Balgooy 5491*, *Kostermans 6628*, and *Kostermans 13046*).

Ecology. In lowland mixed dipterocarp, swamp and *kerangas* forests.

Notes. *D. confertiflora* superficially resembles *D. kurzii*, *D. ferruginescens* and *D. venosa*, but can be distinguished by the asymmetric fruits with consistently 3-lobed calyx, the invisible intercostal venation and the membranaceous parallel-sided leaves. A small leafed form in Sabah (*SAN 68434*, *SAN 118725* and *SAN 128816*) closely resembles *D. clementium* in the vegetative state but does not bear long spreading hairs on the twigs.

13. **Diospyros cordata** (Hiern) Bakh.

(Latin, *cordatus* = heart-shaped; alluding the leaf base)

Gard. Bull. S. S. 7 (1933) 167, *l.c.* (1937) 165, *l.c.* (1955) plate 31. **Basionym:** *Maba cordata* Hiern *l.c.* 141, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Beccari PB 1837*, Borneo, Sarawak (K, photo).

Treelet to 1.5 m tall. **Twigs** *covered with spreading hairs of 0.2–0.3 cm long*. **Leaves** chartaceous, glabrous except for midrib, *drying yellowish*; *narrowly oblong and parallel-sided* to *oblong-obovate*; *14–20 × 3.5–4.5 cm*, *base cordate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *10–15 pairs*, *often inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation prominulous below*, *reticulate*; *petiole c. 0.3 cm long*, densely hairy. **Male flowers** solitary, subsessile; *calyx divided into 4 imbricate lobes*; corolla salverform, *c.* 1.5 cm long. **Female inflorescences**, **flowers** and **fruits** unknown.

Distribution. Endemic to Borneo and known from Sarawak by two collections (*Beccari PB 1837* and *S 45582*).

Notes. *D. cordata* was, until this revision, known only by the type specimen, which is illustrated in Bakhuizen's Plate 31. I was able to match the illustration with *S 45582*, which represents only the second collection of this very rare species. The main diagnostic features are the oblong to oblong-obovate leaves with cordate base, the spreading hairs on the twigs and the yellowish tinge of the dry leaves. *D. everettii* comes close in leaf shape but the leaves drying black on the upper surface, and the twigs are appressed hairy.

14. **Diospyros coriacea** Hiern Fig. 1C.

(Latin, *coriaceus* = leathery; the leaves)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 259; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 346; Masamune *l.c.* 601; Ng *l.c.* (1978) 67; Turner *l.c.* 197. **Type:** *Beccari PB 3455*, Borneo, Sarawak (holotype K).

Tree to 15 m tall. **Twigs** subrugose, drying blackish. **Leaves** *chartaceous*, *glabrous and not subglaucous below*; *narrowly oblong-elliptic*, *6–15 × 2.3–4.3 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins 5–10 pairs*, *prominent below*, *inarching and joining to form intramarginal vein-loops at some distance from leaf margin*; *intercostal venation prominulous below*, *reticulate*; *petiole 0.6–1 cm long*. **Male inflorescences** 1–1.5 cm long, each bearing 3–7 flowers. **Male flowers** with calyx ellipsoid and truncate, mouth fringed by 4–5 small valvate teeth, *c.* 0.3 × 0.2 cm (very young bud). **Female inflorescences** and **flowers** unknown. **Fruits** solitary, subsessile, glabrous, globose, to *3.5 cm diameter*, *smooth*, symmetric. **Fruit calyx** *divided into 4 valvate*, *leafy coriaceous lobes*; *lobes prominently veined*, erect and clasping fruit, 1–1.5 × 1.5–1.75 cm, with plicate sides.

Distribution. Singapore and Borneo. In Borneo, known from Sarawak (e.g., *Beccari PB 1422* and *Beccari PB 3455*) and Kalimantan (e.g., *Hallier 1259*, *Hallier 1284*, *Hallier 1318*, *Hallier 2187*, *Jaheri 1893*, *Main 1914*, *Polak 1907*, and *Polak 1914*).

Notes. *D. coriacea* differs from *D. britanno-borneensis* by its subsessile fruits with erect, leafy, veined and plicate calyx lobes, and the tendency of the lateral veins to form intramarginal vein-loops.

15. **Diospyros crockerensis** Ng Fig. 3A–E.

(of the Crocker Range, Sabah)

Gard. Bull. Sing. 53 (2001) 295. **Type:** *Dewol & Karim SAN 78389*, Borneo, Sabah, Crocker Range (holotype SAN; isotype SING).

Tree to 11 m tall. **Twigs** densely velvety. **Leaves** chartaceous, densely hairy and *not subglaucous below*; *elliptic*, *7–17 × 2.5–8.3 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*, *groove covered with short hairs*; *lateral veins prominent below*, 6–9 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *laxly scalariform*; *petiole c. 0.5 cm long*, densely velvety. **Male inflorescences** *2–4.5 cm long*, each bearing 3–9 flowers at distal ends. **Male flowers** with *calyx divided deeply into 4 narrowly oblong imbricate lobes*; corolla salverform, to *c.* 0.8 cm long. **Female inflorescences** 0.8–2.8 cm long, each terminating in about 3 flowers. **Female flowers** *with calyx divided deeply into*

4 imbricate lobes. **Fruits** usually solitary, on 0.8–2.8 cm long stalks, oblong-ovoid, *to c. 3.5 × 1.5 cm*, with apex gradually tapered to a sharp point, velvety, with thinly woody, smooth wall. **Fruit calyx** non-accrescent; lobes *c.* 0.2 × 0.1 cm.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 78389*, *SAN 11589*, and *SAN 130109*) and Sarawak (e.g., *S 25273*).

Ecology. In hill mixed dipterocarp forest.

16. **Diospyros curranii** Merr.

(H.M. Curran, 1875–?, forest officer of the Bureau of Forestry, Manila, the Philippines)

Philip. J. Sci. Bot. 4 (1909) 306; Bakhuizen *l.c.* (1937) 196. **Type:** *Elmer 12090*, the Philippines, Sibuyan, Capiz Prov., Mt. Giting-Giting (L). **Synonym:** *D. curraniopsis* Bakh. *l.c.* (1933) 168, *l.c.* (1938) 198, Anderson *l.c.* 168, Argent *et al. l.c.* 180.

var. **curranii**

Tree to 30 m tall. **Twigs** drying greyish or brownish or blackish. **Leaves** *chartaceous*, *glabrous*, *often drying with a yellowish tinge below*; *elliptic*, *oblong-elliptic* or *obovate*; *6.5–21 × 2.5–7 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *4–10 pairs*, *often inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation prominulous below*, *finely reticulate*; *petiole 0.5–1 cm long*. **Male inflorescences** 0.5–1.5 cm long, each bearing many tiny crowded flowers. **Male flowers** with *calyx divided halfway into 4–5 valvate triangular lobes*; corolla globose or ellipsoid in bud, 0.1–0.2 cm long. **Female inflorescences** 0.3–1 cm long, sometimes arising on short leafless shoots to 2 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4–5 valvate plicate-auriculate leafy coriaceous lobes*. **Fruits** usually solitary, on 0.3–1 cm long stalks, *globose*, *1.5–2.5 cm diameter*, *symmetric*, *smooth*, *often puckered when dried*, velvety when young. **Fruit calyx** accrescent, *distinctly veined*, forming a plate with plicate reflexed margins, of the same diameter as the fruit or smaller.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (common, e.g., *Elmer 21529*, *SAN 15223*, *SAN 54448*, *SAN 109185*, and *SAN 141554*), Sarawak (e.g., *S 22845*, *S 36779*, *S 48655*, *S 51580*, and *S 67580*) and Kalimantan (e.g., *bb. 10753*, *Endert 4883*, *Kostermans 21374*, and *Sidiyasa 536*).

Ecology. Common in lowland and hill mixed dipterocarp forests, to 900 m elevation.

Notes. In Kalimantan, another variety (var. *kalimantanensis* Ng) occurs (e.g., *Mogea 3569*, *Mogea 3585*, *Mogea 3621*, and *Veldkamp 8148*). This variety differs from the typical one in the fruit calyx being stretched out instead of reflexed, and much enlarged, so that the calyx forms a 5-lobed funnel with the fruit in the centre. However, the male flowers and leaves in this population have not diverged from the rest of the species.

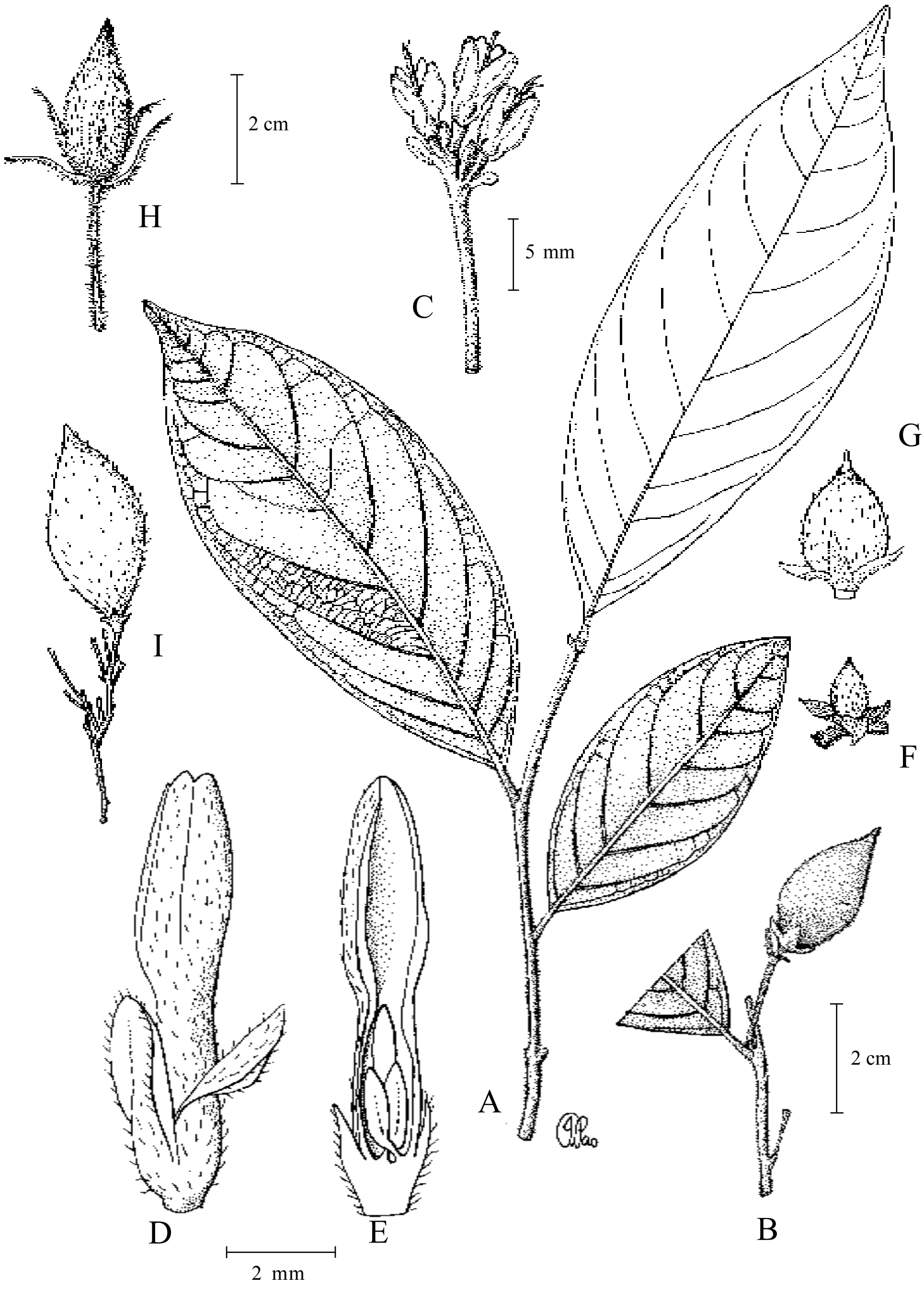

Fig. 3. *Diospyros crockerensis* (A–E); *D. eriantha* (F); *D. euphlebia* (G); *D. ferox* (H); *D. fusiformis* (I). A, leafy twig; B, fruiting leafy twig; C, female flowers after shedding of corollas; D, male flower bud; E, male flower bud in longitudinal section; F–I, fruits. (A–C from *SAN 78389*, D–E from *S 25273*, F from *SAN 26695*, G from *SAN 51537*, H from *SAN 30746*, I from *SAN 73678*.)

17. **Diospyros daemona** Bakh. Fig. 5G.

(Latin, *daemon* = demon; alluding the presumably poisonous fruits)

Gard. Bull. S. S. 7 (1933) 169, *l.c.* (1937) 140; Ng *l.c.* (1978) 67; Turner *l.c.* 197. **Type:** *Henderson SFN 25030*, Peninsular Malaysia, Pahang (holotype SING; isotypes FHO, KEP).

Tree to 20 m tall. **Twigs** velvety in young parts, becoming glabrous with age, drying greyish. **Leaves** membranaceous to chartaceous, tending to crinkle along veins on drying, *not subglaucous and velvety on midrib and lateral veins below*; *elliptic*, *elliptic-obovate* or *elliptic-oblong*, (*7.5–*)*11–21* × (*3–*)*4–10.5 cm*, *base rounded* or *subcordate* to broadly cuneate, *margin not undulate*, *apex acute* to *shortly acuminate*; *midrib sunken* to *prominent above*; *lateral veins prominent below*, *6–13 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominent below*, *laxly scalariform*; *petiole 0.4–1 cm long*. **Male inflorescences** 1–3 cm long, raceme-like, each bearing 3–10 flowers. **Male flowers** with *calyx 4-lobed*, *lobes imbricate*; corolla salverform, to *c.* 1 cm long. **Female inflorescences** 1–3.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 small imbricate rounded lobes*. **Fruits** 1–5, *on 1–3.5 cm long stout stalks*, globose or depressed-globose, *to 6 cm diameter*, symmetric, thick-walled, velvety when young, *maturing smooth and glabrous*, drying black. **Fruit calyx** *not accrescent*; *lobes rounded*, *c. 0.5 × 0.5 cm*, *dwarfed by the fruit.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 46291*, *SAN 54321*, *SAN 72158*, *SAN 85013*, and *SAN 107989*), Sarawak (e.g., *S 13774*, *S 34191*, *S 34773*, and *Jacobs 5183*) and Kalimantan (e.g., *bb. 12051*, *bb. 14750*, *Hallier 384*, *Kostermans 10514*, *Kostermans 21029*, and *Kostermans 21181*).

Notes. The specimens from Peninsular Malaysia tend to be more hairy on the leaf under surface than those from Borneo, and to dry black on the upper surface. The Kalimantan specimens *bb. 12051* and *bb. 14750* were confused with *D. beccarii* (= a synonym of *D. sumatrana*) by Bakhuizen (*l.c.* (1936–41) 239), who inferred that the fruits would be poisonous, because in his system of classification, *D. daemona* came close to *D. insidiosa* (of Peninsular Malaysia and Sumatra), which was reported to have poisoned several people in Acheh who ate the fruits.

18. **Diospyros densa** Bakh.

(Latin, *densus* = dense; alluding its dense foliage)

Gard. Bull. S. S. 7 (1933) 169, *l.c.* (1937) 120; Anderson *l.c.* 168; Argent *et al.* (eds.) *l.c.* 180. **Type:** *bb. 11018*, Borneo, Kalimantan (holotype BO).

Tree to 50 m tall, with large buttresses and black outer bark. **Twigs** appressed hairy when young, becoming glabrous with age, rugose, drying white. **Leaves** chartaceous to coriaceous, glabrous, *drying brownish* or *dull greenish above*, *not subglaucous below*; *elliptic* to *obovate*, *3–8.5 × 1–3 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous below*, *4–8 pairs*, *inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation faint*, *laxly reticulate*; *petiole 0.2–0.3 cm long*. **Male inflorescences** 0.5–1.5 cm long, each bearing usually solitary flower. **Male flowers** *with calyx divided almost to base into 4 long narrow imbricate glabrous lobes of c. 0.4 × 0.1 cm*. **Female inflorescences** 0.5–3.3 cm long, each bearing usually solitary flower. **Female flowers** with *calyx divided into 4 glabrous*, *long*, *narrowly pointed lobes to 2 cm long.* **Fruits** solitary, on slender

0.5–3.3 cm long stalks, globose, to *c. 2.2 cm diameter*, symmetric, thin-walled (often crushed in herbaria), *smooth*, glabrous. **Fruit calyx** *not accrescent*; *lobes narrowly triangular*, *to 2 cm long* and *0.2 cm wide at base*, variably erect, spreading or reflexed.

Distribution. Endemic to Borneo. Known from Sabah (common, e.g., *SAN 19245*, *SAN 44191*, *SAN 61702*, *SAN 97105*, and *SAN 139653*), Sarawak (e.g., *S 24373*), Kalimantan (e.g., *bb. 11018*, *bb. 26233* and *Kostermans 9098*), and Brunei (e.g., *BRUN 17767*).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. densa* can be distinguished by its larger calyx lobes from *D. graciliflora*.

19. **Diospyros dictyoneura** Hiern Fig. 1D.

(Greek, *dictyon* = net, *neuron* = sinew, nerve; having net-like venation)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 192; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 257; Masamune *l.c.* 601; Ng *l.c.* (1978) 68; Anderson *l.c.* 168; Turner *l.c.* 197; Coode *et al.* (eds.) *l.c.* 88; Argent *et al.* (eds.) *l.c.* 180; Beaman *et al. l.c.* 227. **Syntypes:** *Beccari PB 2542* and *Beccari PB 2615*, Borneo (all at K).

Tree to 30 m tall. Shoots growing in intermittent flushes. **Twigs** glabrous, rugose. **Leaves** *membranaceous* to *chartaceous*, glabrous, *not subglaucous below*; *ovate*, *elliptic*, *oblong-elliptic*, or *obovate*, *c. 5.5 × 3.5 cm* (proximal leaves) to *c. 22 × 10 cm* (distal leaves of a flush), *base subcordate*, *rounded* or *cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*, *wrinkled below on drying*; *lateral veins 4–12 pairs*, *prominent below*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *densely* and *finely reticulate*; *petiole 0.5–1.3 cm long*, *characteristically coarsely wrinkled on drying*. **Inflorescences** *borne on basal nodes of new flushes*. **Male inflorescences** to *c.* 3 cm long, each bearing many flowers. **Male flowers** with *calyx divided into 4* or *5 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** 1.5–4 cm long, each bearing usually solitary flower. **Female flowers** with *calyx divided into 5 valvate lobes*. **Fruits** solitary, on 1.5–4 cm long stalks, ellipsoid, to *c. 4.5 × 3.5 cm*, symmetric, hairy, *not ribbed.* **Fruit calyx** *accrescent*; *lobes* to *c. 2 × 2 cm* or *larger*, *leafy*, *prominently veined*, *coriaceous*, *erect*, *margins dilated and plicate.*

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN A 1349*, *SAN 36752* and *SAN 39879*), Sarawak (e.g., *Pennington 8007*, *S 15705*, *S 23936*, *S 48415*, and *S 69767*) and Brunei (e.g., *Ashton 7868*, *Chin et al. 460*, *S 7868*, and *SAN 17466*).

Ecology. In lowland mixed dipterocarp forest.

20. **Diospyros diepenhorstii** Miq.

(H. Diepenhorst, 1811–1860?, a Dutch district officer and botanist in Sumatra)

Fl. Ind. Bat. Suppl. (1860) 250 & 583; Bakhuizen *l.c.* (1937) 142; Ng *l.c.* (1978) 68; Anderson *l.c.* 168; Turner *l.c.* 197; Argent *et al.* (eds.) *l.c.* 180; Beaman *et al. l.c.* 227. **Type:** *Diepenhorst HB 2176*, W Sumatra, Priaman (L, U).

Tree to 30 m tall. **Twigs** brownish to blackish, glabrous, *rugose*. **Leaves** chartaceous to coriaceous, glabrous, *not subglaucous below*; *oblong*, *13–50 × 4.5–14 cm*, *base rounded* to *subcordate*, apex acute to acuminate; midrib sunken above; *lateral veins* prominent below, 8–15 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominent below*, *laxly reticulate*; petiole 0.7–2.3 cm long. **Inflorescences** *borne on tree trunk and larger branches.* **Male inflorescences** *c.* 2 cm long, each bearing many flowers. **Male flowers** with calyx divided into 5, 6 or 7 imbricate lobes. **Female inflorescences** *c.* 4 cm long, each bearing several clustered flowers. **Female flowers** with calyx divided about halfway into 6 imbricate lobes. **Fruits** in clusters, each terminating a 4 cm long stalk, obovoid to oblong-ellipsoid, to *c. 10 × 6 cm*, symmetric, glabrous, *vertically ribbed*, ripening soft and yellow, edible. **Fruit calyx** slightly accrescent, *forming a shallow cup with 6 shallow lobes* of *c.* 0.5 × 1.3 cm.

Vernacular name. Sabah—*kayu malam* (preferred name).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (common, e.g., *SAN 16407*, *SAN 25060*, *SAN 38831*, *SAN 97662*, and *SAN 140525*), Sarawak (e.g., *S 4323*, *S 13800*, *S 32605*, *S 49005*, and *S 13840*) and Kalimantan (e.g., *Jarvie & Ruskandi 5350*, *Kostermans 10437* and *Kostermans 13840*).

Ecology. In lowland and hill mixed dipterocarp to lower montane forests, to 1800 m altitude.

Notes. The large oblong leaves with subcordate to rounded bases, lax reticulations and the large fruits with 6-lobed calyx, are diagnostic.

21. **Diospyros discocalyx** Merr.

(Latin, with disc-shaped fruit calyx)

PEB (1929) 245; Bakhuizen *l.c.* (1938) 316; Masamune *l.c.* 601. **Type:** *Elmer 21898*, Borneo, Sabah, Tawau (L, SING).

Tree to 50 m tall, *c.* 1 m diameter, unbuttressed or with small symmetrical buttresses to *c.* 1 × 1 m. **Bark** black; inner bark bright yellow. **Sapwood** white. **Twigs** tuberculate-lenticellate, *rugose*, glabrous. **Leaves** membranaceous to chartaceous, not bullate, *not subglaucous beneath*, glabrous; *elliptic* to *obovate*, *8–20 × 3.5–8 cm*, *base attenuate*, apex acuminate; midrib *sunken above*; *lateral veins prominulous on both sides*, *5–10(–12) pairs*, *curving steeply upwards and forming multiple loops in the apical half of leaf*; *intercostal venation prominulous below*, *vaguely reticulate*; petiole 0.5–1.3 cm long, upper limit imprecise because of the attenuate leaf base. **Male inflorescences** 1–2 cm long, each bearing 3 or more flowers. **Male flowers** with calyx in the form of a narrow cup, *c.* 0.6 × 0.4 cm, truncate or shallowly 4-lobed; corolla 1–1.5 cm long, oblong-conic in bud. **Female inflorescences** *c.* 1.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx* truncate or globose, with a hole at the top through which protrudes the corolla. **Fruits** solitary, on 0.6–1 cm long stalks, initially ovoid, eventually become woody and *globose*, *to c. 7.5 cm diameter*, *smooth*, glabrous, symmetric. **Fruit calyx** accrescent, *initially cup-shaped and covering the basal half of fruit*, *later expanded into a 4–5 cm diameter woody dish*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 16093*, *SAN 26044*, *SAN 44880*, *SAN 82093*, and *SAN 129558*) and Kalimantan (e.g., *Kostermans 5107*).

Ecology. In lowland mixed dipterocarp forest, but once recorded at 1600 m altitude (*SAN 59664*).

Notes. This is probably the biggest *Diospyros* in Borneo. It is easily distinguished by its attenuate leaf base and the lateral veins anastomosing and forming multiple loops in the apical half of the leaf. The male flowers may be mistaken for those of *D. korthalsiana* because of the similar calyx.

22. **Diospyros elliptifolia** Merr. Fig. 1E.

(Latin, *elliptifolius* = with elliptic leaves)

Philip. J. Sci. 30 (1926) 421, *l.c.* (1929) 247; Fischer *l.c.* 247; Bakhuizen *l.c.* (1938) 232; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88 (including *D. cf. elliptifolia*); Argent *et al.* (eds.) *l.c.* 182; Ng *l.c.* (2001) 309. **Type:** *Ramos & Edano 44020*, the Philippines, Sulu Archipelago, Tawi-tawi (SING). **Synonyms:** *D. elliptifolia* forma *kinabaluensis* Bakh. *l.c.* (1938) 233; *D. kinabaluensis* (Bakh.) Kosterm. *l.c.* 460, Beaman *et al. l.c.* 228.

Tree to 18 m tall. **Twigs** not tending to dry black. **Leaves** chartaceous, glabrous, *not subglaucous below*; *obovate*, *elliptic* or *oblong*, *8–17*(*–32*) × *4–9.5*(*–12*) *cm*, *base attenuate*, apex shortly acuminate; *midrib grooved above*, *with prominently raised rims*, *especially toward base*, *and often conspicuously black against a light greenish brown leaf under surface*; *lateral veins prominent below*, 5–10 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous on both sides*, *reticulate*, or sometimes invisible; *petiole very short*, *0.2–0.5 cm long*, *leaf almost subsessile* because of the attenuate base. **Male inflorescences** *c.* 0.3 cm long, each bearing up to 3 flowers. **Male flowers** with calyx divided into 4 or 5 valvate triangular lobes; corolla *c.* 0.7 cm long, urceolate. **Female inflorescences** 0.1–0.5 cm long, each bearing usually solitary flower. **Female flowers** with calyx deeply divided into 4–5 leafy valvate lobes of 0.7–1 × 0.5–1.5 cm. **Fruits** solitary, subsessile, globose, *1.5–3 cm diameter*, often with a pointed apical protuberance, drying shining black, *smooth*, finely hairy, symmetric. **Fruit calyx** not or slightly accrescent; *lobes leafy coriaceous*, *veined*, erect, to *c. 1.5 × 1.5 cm*, sides expanded and slightly plicate.

Distribution. Sumatra, Borneo and the Philippines. In Borneo, known from Sabah (very common, e.g., *Pereira 459*, *RSNB 4175*, *SAN 22905*, *SAN 90411*, and *SAN 14069*), Sarawak (e.g., *Haviland 1740*, *S 3942*, *S 41875*, *S 53917*, and *S 65446*), Brunei (e.g., *BRUN 909*, *Dransfield 7029*, *Forman 1139*, *Sands 5864*, and *Simpson 2146*), and Kalimantan (e.g., *Burley et al. 710*, *Endert 3582*, *Kostermans 5038*, and *Meijer 2331*).

Ecology. In lowland and hill mixed dipterocarp forests, to 800 m altitude.

Notes. Diagnostic features are the almost subsessile leaves, with attenuate base, and the midrib above appearing as a groove with raised rims, the shiny black subsessile fruits and the leafy, veined calyx lobes. The leaves vary greatly in size but I cannot find any justification for Kosterman's elevation of forma *kinabaluensis* to the status of a separate species. In fact I cannot sustain it even as a form. *D. eucalyptifolia* is similar except for its willow-like or eucalypt-like narrow, slightly curved leaves.

23. **Diospyros eriantha** Champ. *ex* Benth. Fig. 3F.

(Greek, *erion* = wool, *anthos* = flower; with the flowers covered with woolly hairs)

In Hooker's J. Bot. 4 (1852) 302; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 182; Masamune *l.c.* 602. **Type:** *Cunningham s.n.*, Hong Kong (holotype K).

Tree to 7 m tall. **Twigs** *hairy when young*, *becoming glabrous with age.* **Leaves** chartaceous, hairy on midrib and lateral veins below, tending to dry black above; 6–9.5 × 2.5–4 cm, *base cuneate* to slightly attenuate, apex acuminate; midrib raised above and hairy; *lateral veins* prominent below, 4–6 pairs, *arching and diminishing toward leaf margin*; *intercostal venation faint on both sides*, *scalariform*, *spaced 0.1–0.2 cm apart*; petiole 0.2–0.3 cm long. **Male** and **female inflorescences** and **flowers** unknown. **Fruits** solitary, subsessile, *ellipsoid*, *c. 1 × 0.5 cm*, symmetric, sparsely hairy, with pointed apex, shiny black. **Fruit calyx** not accrescent, 4-lobed; lobes hairy, leafy coriaceous, triangular-ovate, erect, *c.* 0.7 × 0.4 cm, covering the base of fruit.

Distribution. S China, Indo-China, Sumatra, Java, Borneo, and the Philippines. Rare in Borneo and known from Sabah (e.g., *Wood 2525* and *SAN 26695*) and Kalimantan (according to Bakhuizen). Bakhuizen also cited a specimen from Peninsular Malaysia (*FMS 10445*) but this has been excluded from the species (Ng, *l.c.* (1978) 94).

24. **Diospyros eucalyptifolia** Bakh.

(Latin, with leaves resembling those of *Eucalyptus*)

Gard. Bull. S. S. 7 (1933) 172; Bakhuizen *l.c.* (1938) 232; Masamune *l.c.* 602. **Type:** *Amdjah 255*, Borneo, Kalimantan, Sedalir (holotype BO; isotype L).

Treelet to 5 m tall. **Leaves** chartaceous to coriaceous, *not subglaucous below*, glabrous, subsessile; *narrowly oblong-elliptic*, *willow-like*, *tapered gradually to apex and base*, 6–15(–25) × 1.5–3(–4.5) cm, *base attenuate*, apex long-acuminate and often slightly curved; midrib sunken into a groove above, with raised rims especially toward base; *lateral veins* prominent below, *c.* 5 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous*, *laxly reticulate*; petiole 0.2–0.3(–0.5) cm long. **Male** and **female inflorescences** and **flowers** unknown. **Fruits** solitary, subsessile, on 0.2–0.7 cm long stalks, globose or ovoid, to *c. 2 cm diameter*, shiny black, with an acuminate beak or apical point, *smooth*, glabrous, symmetric. **Fruit calyx** *not accrescent*, *divided almost to base into* (*3–*)*4 valvate lobes*; *lobes leafy coriaceous*, *erect*, *c. 1.5 × 1.5 cm*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 129568*), Sarawak (e.g., *S 38037* and *S 49738*) and Kalimantan (e.g., *Amdjah 255*, *type*).

Ecology. In lowland and hill mixed dipterocarp forests, to 900 m altitude. The Sabah specimen was growing on the banks of a rocky river.

Notes. The narrow leaves resemble those of *D. lanceifolia* var. *saliciformis* and the riverine form of *D. andamanica. D. eucalyptifolia* may, when flowers become available, prove to be merely a narrow-leafed form of *D. elliptifolia*.

25. **Diospyros euphlebia** Merr. Fig. 3G.

(Greek, *eu-* = well-developed, *phlebos* = vein; referring to the well-veined leaves)

PEB (1929) 241; Bakhuizen *l.c.* (1937) 168; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88. **Type:** *Elmer 20756*, Borneo, Sabah, Tawau (BO, L, SING).

Tree to 13 m tall. **Twigs** thick, *usually with rough corky bark*, hairy in young parts, becoming glabrous with age. **Leaves** membranaceous to chartaceous, glabrous or hairy below, bullate between veins, tending to dry black above, *not subglaucous below*; *oblong-obovate*, *20–40 × 6–13 cm*, *base rounded*, *subcordate* or *cordate*, apex acute to shortly acuminate; midrib sunken above; *lateral veins* sunken above, prominent below, 7–11 pairs, *tending to inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation sunken above*, *prominent below*, *laxly reticulate*; petiole 0.5–1.2 cm long (leaf almost subsessile in relation to its size). **Male inflorescences** and **flowers** unknown. **Female inflorescences** 0.1–0.2 cm long, each bearing 1–15 crowded flowers, arising from axils of extant leaves and sometimes on large leafless branches. **Female flowers** with calyx divided halfway into 5 imbricate triangular lobes; corolla salverform, *c.* 1 cm long. **Fruits** usually solitary, subsessile, ovoid, with a pronounced beak or point, to *c.* 3.5 × 2 cm, thin-walled, covered with bristly hairs especially when young, symmetric. **Fruit calyx** not accrescent; *lobes c. 0.2 × 0.2 cm*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *Kokawa & Hotta 2307*, *Ridsdale 1940*, *SAN 52007*, *SAN 85137*, and *SAN 136152*), Sarawak (e.g., *S 13981* and *S 16040*), Brunei (e.g., *Coode 7905*), and E Kalimantan (e.g., *Ambri M 1573*).

Notes. The corky bark, the large subsessile oblong-obovate leaves with cordate/subcordate base which dry black above, the sunken midrib, lateral and intercostal veins, the lax reticulations, and the subsessile flowers and fruits make this species easy to recognise. However, *SAN 107635* does not have corky twigs. *D. muricata* comes close but has smaller leaves and more slender, non-corky twigs.

26. **Diospyros evena** Bakh. Fig. 6D.

(Latin, *evenus* = without veins; referring to invisible veins of the leaf)

Gard. Bull. S. S. 7 (1933) 163, *l.c.* (1937) 93; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88; Argent *et al.* (eds.) *l.c.* 182. **Syntypes:** *Haviland & Hose 3348*, Borneo, Sarawak (SAR); *bb. 7264*, *bb. 7789* and *bb. 12643*, Borneo, Kalimantan (all at BO). **Synonym:** *Maba motleyi* Hiern *l.c.* 483, *p.p.*, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607.

Tree to 25 m tall. **Twigs** *drying consistently black*, hairy in young parts, becoming glabrous with age. **Leaves** *coriaceous*, glabrous, *drying consistently black on both sides*; *obovate* or *oblong-elliptic*, 3.5–8(–12) × 1.5–3.5(–4.5) cm, base sequentially subcordate, rounded and cuneate on a flush, *apex acute*, *rounded* or *retuse* (rarely acuminate); midrib sunken above; lateral veins invisible; *intercostal venation invisible*; petiole 0.3–0.5 cm long. **Male inflorescences** 0.1–0.2 cm long, each bearing solitary flower. **Male flowers** with calyx divided into 4 imbricate rounded lobes; corolla salverform, *c.* 0.8 cm long. **Female inflorescences** and **flowers** unknown. **Fruits** solitary, on *c.* 0.3 cm long stalks, oblong, *c.* 2.3 × 1.3 cm, without acuminate beak at top, woody, smooth, glabrous, symmetric. **Fruit calyx** not accrescent, divided into 4 rounded imbricate lobes, each lobe *c.* 0.2 × 0.3 cm.

Vernacular name. Sarawak—*merpinang daun kecil* (preferred name).

Distribution. Sumatra and Borneo. In Borneo, known from Sabah (common, e.g., *FRI 41333*, *Kokawa & Hotta 2669*, *SAN 22293*, *SAN 84289*, and *SAN 140539*), Sarawak (common, e.g., *S 4953*, *S 5044*, *S 12887*, *S 30162*, and *S 44295*), Brunei (e.g., *BRUN 549*, *BRUN 700*, *S 5552*, *S 5855*, and *Sinclair & Kadim 10498*), and Kalimantan (e.g., *bb. 12643*, *Buwalda 7835*, and *Kostermans 9276*).

Ecology. Locally very common in freshwater swamp forests, especially in Sarawak.

Notes. Closely related to *D. maingayi* and *D. puncticulosa*, which also have leaves drying black and have virtually invisible intercostal venation.

27. **Diospyros everettii** Merr.

(H.D. Everett, 1880–1908, a forest officer at the Philippines Bureau of Forestry)

Philip. J. Bot. 4 (1909) 307; Bakhuizen *l.c.* (1937) 167; Masamune *l.c.* 602. **Type:** *Everett 7261*, the Philippines (*n.v.*).

Tree to 15 m tall. **Twigs** *appressed hairy*. **Leaves** chartaceous, glabrous, *not subglaucous below*; *oblong* to *oblong-obovate*, *13–19 × 3–5 cm*, *base subcordate*, *margin not undulate*, *apex acute* to *acuminate*; *midrib sunken above*; *lateral veins prominent below*, 6–11 pairs, *somewhat inarching and joining to form intramarginal vein-loops at a distance from leaf margin*; *intercostal venation prominulous below*, *reticulate* to *vaguely scalariform*; *petiole 0.3–0.8 cm long*. **Male inflorescences** 0.3–0.5 cm long, each bearing about 6 flowers. **Male flowers** with *calyx divided deeply into 4 oblong imbricate lobes*; corolla salverform, *c.* 0.8 cm long. **Female inflorescences** and **flowers** unknown. **Fruits** *c.* 6, on a 0.3–1 cm long stalk, globose, *c. 1 cm diameter* (immature), *densely velvety*, *puckered when dry*. **Fruit calyx** *not accrescent*, *divided into 4 rounded imbricate lobes of c. 0.3 × 0.3 cm*.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *Fraser 203*, *fide* Bakhuizen) and Kalimantan (e.g., *Amdjah 787*, *Amdjah 861*, *Kostermans 5303*, *Kostermans 8682*, and *Meijer 2367*).

Notes. The above description is based on the Kalimantan specimens. *D. everetii* differs from *D. muricata* in the midrib sunken instead of prominent above.

28. **Diospyros ferox** Bakh. Fig. 3H.

(Latin, *ferox* = fierce-looking; alluding the rusty bristles on the twigs, lower leaf surface, inflorescences, and fruits)

Gard. Bull. S. S. 7 (1933) 170; Bakhuizen *l.c.* (1937) 162; Masamune *l.c.* 603; Coode *et al.* (eds.) *l.c.* 88. **Type:** *Native Collector 137*, Borneo, Sarawak (holotype BO; isotype L).

Tree to 10 m tall, rarely to 20 m. **Twigs** *densely covered with spreading rusty hairs*. **Leaves** chartaceous, *softly densely rusty hairy below*, *tending to dry black above*; *oblong* to *oblong-ovate*, somewhat parallel-sided, *3.5–12 × 1–3.6 cm*, *base rounded* to *subcordate*, *margin not undulate*, *apex acuminate*; *midrib sunken above* and *the groove filled with spreading rusty hairs*; *lateral veins prominulous below*, *6–13 pairs*, *faintly inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation* invisible above, *prominulous below*, *reticulate*; *petiole 0.1–0.2 cm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** rusty hairy, slender, 0.4–3 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 filiform valvate lobes*, *densely covered with spreading rusty hairs*. **Fruits** often solitary, *oblong-ovoid*, *beaked and c. 3 × 1.2 cm* or *globose and c. 2 cm diameter*, *rusty hairy*, *not ribbed*, thin-walled, symmetric. **Fruit calyx** not accrescent; *lobes filiform*, *c. 1.5 × 0.1 cm*, *covered with spreading rusty hairs*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 30736*, *SAN 46643*, *SAN 52233*, *SAN 93955*, and *SAN 101128*), Sarawak (e.g., *S 18043*, *S 42215*, *S 62113*, and *FRI 38978*), Brunei (e.g., *Sinclair 10509*), and Kalimantan (e.g., *Shea 27147*).

Ecology. In peat swamp, lowland and hill mixed dipterocarp forests, to 900 m altitude.

Notes. The spreading rusty hairs on twigs, leaves, fruits and calyces, and the filiform calyx lobes are highly diagnostic. There are forms with globose fruits (Sarawak) and forms with beaked fruits (Sabah, e.g., *SAN 39107*).

29. **Diospyros ferrea** (Willd.) Bakh.

(Latin, *ferreus* = pertaining to iron; probably alluding the hard wood)

Gard. Bull. S. S. 7 (1933) 162, *l.c.* (1937) 50; Ng *l.c.* (1978) 71; Turner *l.c.* 197. **Basionym:** *Ehretia ferrea* Willd., Phytogr. 1 (1794) 4. **Type:** unknown. **Synonyms:** *Pisonia buxifolia* Rottb., Nov. Act. Hafn. 2 (1783) 536; *Maba buxifolia* (Rottb.) Juss., Ann. Mus. Hist. Nat. 5 (1804) 418, Merrill *l.c.* (1929) 240, Masamune *l.c.* 606.

Treelet to 5 m tall. **Leaves** chartaceous, glabrous, *not subglaucous below*; *obovate*, *4–8.5 × 2–4 cm*, *base cuneate*, *margin not undulate*, *apex rounded*, *retuse* or *acute*; *midrib sunken* to *shallowly depressed above*; *lateral veins prominulous below*, *4–5 pairs*, *inarching and anastomosing to form intramarginal vein-loops at a distance from leaf margin*, leaving space for more loops to form closer to leaf margins; *intercostal venation prominulous on both sides*, *reticulate*; *petiole 0.2–0.3 cm long*. **Male inflorescences** 0.1–0.2 cm long, each bearing 3 tiny flowers. **Male flowers** with *calyx divided halfway into 3 triangular valvate lobes*. **Female inflorescences** 0.1–0.2 cm long, each bearing usually solitary flower. **Female flowers** with *calyx divided halfway into 3 valvate lobes*. **Fruits** solitary, on 0.1–0.2 cm long stalks, globose, *c. 0.8 cm diameter*, glabrous, *smooth*, symmetric. **Fruit calyx** accrescent, *forming a shallow three-pointed dish* or *cup of about the same diameter as fruit*.

Distribution. A very widespread species, from West Africa to India, Burma, Thailand, Indo-China and throughout Malesia to Australia and the South Pacific Islands. In Borneo, known from Sabah (e.g., *Elmer 21096*, *Keith 7389*, *FMS 41507*, *SAN 76115*, and *SAN 135372*), on coasts and small islands, and Sarawak (once only, *S 31976*) on summit of a limestone hill at G. Subu in Miri district.

30. **Diospyros ferruginescens** Bakh.

(Latin, *ferruginescens* = becoming rusty-red; referring to the indumentum)

Bull. Jard. Bot. Buitenz. 3, 15 (1941) 409; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88. **Syntypes:** *bb. 26182*, *bb. 29294*, *bb. 29305*, and *bb. 29375*, Borneo, Kalimantan, Nunukan (BO, L).

Tree 20–36 m tall. **Twigs** and buds densely velvety or rusty hairy, tending to dry black. **Leaves** membranaceous to chartaceous, glabrous to *densely rusty hairy and not subglaucous below*, tending to dry black above; *oblong-elliptic*, *oblong and parallel-sided*, or *elliptic*, *4–15 × 1.5–5.5 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*, groove often filled with hairs, *prominent and velvety hairy below*; *lateral veins prominulous to prominent below*, *6–10 pairs*, *inarching strongly at margins* or *diminishing toward leaf margin*; *intercostal venation very faint* to *prominulous below*, *reticulate* and often stretched parallel to lateral veins; *petiole 0.5–0.7 cm long*. **Male inflorescences** 0.2–0.7 cm long, each bearing (1–)3–9 flowers. **Male flowers** with *calyx divided one third to one fourth down into 4–5 valvate triangular lobes* or *teeth*; corolla salverform, 0.5–0.7 × 0.2 cm. **Female inflorescences** 0.1–0.3 cm long, each usually bearing solitary flower. **Female flowers** with *calyx divided halfway into 4–5 valvate triangular lobes*. **Fruits** solitary, on 0.1–0.3 cm long stalks, *globose to nearly so*, *1.5–2.5 cm diameter*, *symmetric*, *not ribbed*, woody, densely velvety rusty hairy. **Fruit calyx** accrescent, *divided deeply into 4–5 triangular valvate lobes*; lobes coriaceous, erect or spreading, 0.5 × 0.3–0.4 cm, forming a 4–5-pointed star.

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In lowland and hill mixed dipterocarp and lower montane forests, to 1500 m altitude.

Key to varieties

Leaves with lateral veins prominulous below, diminishing towards leaf margin; usually glabrous...

var. **ferruginescens**

In Borneo, known from Sabah (e.g., *SAN 13128*, *SAN 36880*, *SAN 44513*, *SAN 80199*, and *SAN 133272*), Sarawak (common, e.g., *Asah 5305*, *Chew CWL 1170*, *S 10320*, *S 14499*, and *S 61701*), Brunei (e.g., *BRUN 592*, *BRUN 15456*, *Dransfield JD 7267*, and *SAN 17128*), and Kalimantan (e.g., *bb. 26182* and *Kostermans 8607*). In lowland and hill mixed dipterocarp to lower montane forests, to 1500 m altitude.

Leaves with lateral veins prominent below, strongly inarching near leaf margin; usually densely rusty hairy below..

var. **rufotomentosa** Ng

(Latin, *rufus* = reddish, *tomentosus* = thickly and evenly covered with hairs; the lower leaf surface)

Gard. Bull. Sing. 53 (2001) 305. Type: *Maikin et al. SAN 132942*, Borneo, Sabah, Lumaku FR (holotype SAN).

Tree to 20 m tall.

In Borneo, known from Sabah (e.g., *SAN 55535*, *SAN 66013*, *SAN 102122*, *SAN 113977*, *SAN 132942*, and *SAN 139235*) and Kalimantan (e.g., *Kostermans 8602*, *Kostermans 8778* and *Kostermans 10755*). In lowland and hill mixed dipterocarp forests, to 700 m altitude.

31. **Diospyros foxworthyi** Bakh. Fig. 2D.

(F.W. Foxworthy, 1877–1950, American botanist and forest research officer at Kepong)

Gard. Bull. S. S. 7 (1933) 171, *l.c.* (1938) 293; Ng *l.c.* (1978) 71; Turner *l.c.* 197; Ng *l.c.* (2001) 309. **Type:** *Foxworthy FMS 10447*, Peninsular Malaysia, Perak (KEP). **Synonyms:** *D. levigata* Bakh. *l.c.* (1933) 175, *l.c.* (1938) 294, Masamune *l.c.* 604, Argent *et al.* (eds.) *l.c.* 185; *D. cylindrocarpa* Kosterm. *l.c.* 456, Beaman *et al. l.c.* 227.

Tree to 20 m tall. **Leaves** chartaceous to coriaceous, *glabrous*; oblong-elliptic, 10–35 × 3.5–12 cm, base cuneate to rounded, *apex long-acuminate* to *caudate*; midrib sunken above; *lateral veins* sunken or flush above, prominent below, (6–)10–15 pairs, mostly *joining strongly at margin to form an intramarginal vein close to leaf margin*; *intercostal venation flush* to *prominulous above*, *prominent below*, *reticulate*; petiole 0.8–1.5 cm long. **Male inflorescences** 1–4.5 cm long, slender, each bearing 3–15 flowers. **Male flowers** with calyx divided halfway into 4 valvate triangular lobes; corolla salverform, *c.* 0.6 cm long. **Female inflorescences** 1–3.5 cm long, each bearing 1–several flowers. **Female flowers** with calyx divided into 4 valvate triangular lobes of *c.* 0.5 × 0.6 cm. **Fruits** in clusters of 1–5, on stout 1–3.5 cm long stalks, velvety and globose when young, maturing glabrous, oblong, to *5 × 4.5 cm*, symmetric, on drying tending to shrink into as many longitudinal furrows as there are seeds (maximum of 8 seeds). **Fruit calyx** slightly accrescent, forming a shallow woody 4-pointed plate of 1.5–3 cm diameter; lobes with erect tips and slightly dilated and reflexed sides.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 16505*, *SAN 40665*, *SAN 75770*, *SAN 100196*, and *SAN 141584*), Sarawak (common, e.g., *Hotta 6121*, *Jacobs 3947*, *S 15910*, *S 36229*, and *S 63711*) and Kalimantan (e.g., *bb. 32302*, *Burley et al. 3145*, *Jacobs 5220*, and *Kostermans 21178*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The intramarginal veins of the Bornean specimens are nearly always strongly developed, while that of the Peninsular Malaysian specimens are weakly developed. There are, however, intermediate specimens (e.g., *SAN 55682* and *SAN 92760*) which justify treating all the specimens under one species.

32. **Diospyros frutescens** Blume

(Latin, *frutescens* = shrubby; the growth habit)

Bijdr. Fl. Ned. Ind. (1825) 668; Bakhuizen *l.c.* (1938) 192; Ng *l.c.* (1978) 73; Anderson *l.c.* 168; Turner *l.c.* 197; Beaman *et al. l.c.* 227. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *D. atra* Merr. *l.c.* (1929) 242, Masamune *l.c.* 601.

Tree to 18 m tall. **Twigs** puberulous when young, becoming glabrous with age, sparsely lenticellate, drying blackish. **Leaves** *membranaceous*, slightly bullate between veins, *glabrous*, *not subglaucous below*; *elliptic*, *13–25*(*–35*) × *4.5–10*(*–13.5*) *cm*, *base rounded* to *cuneate*, *margin not undulate*, *apex acute* to *acuminate*; *midrib sunken above*; *lateral veins sunken above*, *prominent below*, *6–11 pairs*, *faintly inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation prominulous below*, *laxly reticulate*; *petiole 0.8–1.3 cm long*. **Male inflorescences** laxly branched, 1–2 cm long, each bearing 3–10 or more flowers. **Male flowers** with *calyx deeply divided into 4 narrowly triangular valvate lobes*; corolla ovoid in bud, to *c.* 0.5 cm long. **Female inflorescences** *c.* 0.8 cm long, each bearing 3–10 flowers. **Female flowers** with *calyx divided into 4 plicate-auriculate valvate lobes*. **Fruits** in clusters of 1–3, on stalks of *c.* 0.8 cm long, *globose*, to *c. 2 cm diameter*, *symmetric*, *smooth*, *glabrous*, often puckered on drying. **Fruit calyx** *accrescent*; *lobes leafy coriaceous and auriculate*, *c. 0.8 × 0.8 cm*.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, and Sulawesi. In Borneo, known from Sabah (common, e.g., *SAN 30075*, *SAN 56230*, *SAN 88179*, *SAN 96478*, and *SAN 134543*), Sarawak (e.g., *Fuchs 21209*, *S 41969* and *S 53446*), Brunei, and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, to 800 m altitude.

Notes. A specimen, *Fuchs 21209*, from Sarawak has exceptionally large leaves, up to 35 × 13.5 cm. *SAN 133318* has an exceptionally small fruit calyx only *c.* 0.5 cm across. *D. tuberculata* has similar but asymmetric fruits. There is also some resemblance to *D. piscicarpa* but in *D. piscicarpa* the leaves are not bullate, the lateral veins prominulous (not sunken) above, and the fruits are larger, up to 5 cm diameter.

33. **Diospyros fusiformis** Kosterm. Fig. 3I.

(Latin, *fusiformis* = spindle-shaped; alluding the shape of fruit)

Blumea 23 (1977) 457. **Type:** *SAN 21228*, Borneo, Sabah, Sepilok FR (holotype L; isotype SAN).

Tree to 15 m tall. **Leaves** chartaceous, *glabrous*, *not subglaucous below*; *ovate* or *elliptic*, *4–11.5*(*–13*) × *1.5–4*(*–6*) *cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib shallowly impressed above*; *lateral veins* prominulous on both sides, *4–6 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation faint*, *laxly reticulate*; *petiole 0.3–0.6 cm long*. **Male inflorescence** consisting of 1–10 or more small flowers, sometimes umbel-like, each flower borne on a characteristically slender threadlike 0.5–1 cm long pedicel, *arising from a slender 1–6.5 cm long peduncle*. **Male flowers** with *calyx divided halfway into 4 valvate triangular lobes*; corolla salverform, *c.* 0.8 cm long. **Female inflorescences** resembling the males. **Female flowers** with *calyx divided halfway into 4 valvate triangular lobes*. **Fruits** 1 or more on 1–6.5 cm long stalks, *ovoid to spindle-shaped*, with prominent beak, *to c. 4 × 1.7 cm*, *symmetric*, *not ribbed*, covered sparsely with long bristly appressed hairs when young. **Fruit calyx** *not accrescent*; *lobes 4*, *triangular-ovate*, *c. 1 × 1 cm.*

Distribution. Endemic to Borneo. Known from Sabah (locally common at Sepilok FR in Sandakan district and Gunong Silam VJR in Lahad Datu district, e.g., *SAN 21244*, *SAN 48699*, *SAN 52388*, *SAN 76255*, and *SAN 141526*), Sarawak (once only, *S 42858* from Limbang), and Brunei (e.g., *Davies L 349*, *Davies L 645* and *K 800*).

Ecology. In lowland and hill mixed dipterocarp forests, to 600 m altitude.

34. **Diospyros graciliflora** Hiern Fig. 6E.

(Latin, *gracilis* = slender, *florum* = flower; referring to the slender inflorescence)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 191; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1937) 119; Masamune *l.c.* 603; Anderson *l.c.* 168. **Type:** *Beccari PB 1560*, Borneo (K, photo).

Tree to 10 m tall. **Twigs** slender, appressed hairy, *not tending to dry black*. **Leaves** membranaceous, glabrous, *drying shining above*, *dull and not glaucous beneath*; *elliptic* or *rhombic*, *1.6–6.5 × 0.7–2.9 cm*, base cuneate (where leaves are elliptic) to acuminate (where leaves are rhombic), *apex acuminate* to *caudate*; midrib, sunken above, groove filled with hairs; lateral veins prominulous below, *3–4 pairs*, faintly arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole 0.1–0.3 cm long. **Male inflorescences** slender, *0.7–2.5 cm long*, each bearing 1–4 flowers. **Male flowers** with calyx divided into 4 small *c.* 0.1 × 0.1 cm imbricate ovate lobes; corolla salverform, 0.7–1.3 cm long. **Female inflorescences** filiform, *0.7–2.5 cm long*, each bearing solitary flower. **Female flowers** with calyx divided into 4 small imbricate ovate or rounded lobes. **Fruits** solitary, *on slender 0.7–2.5 cm long stalks*, *globose*, *c. 1.5 cm diameter*, *thin-walled* (brittle and easily crushed on herbarium specimens), sparsely hairy, smooth, symmetrical. **Fruit calyx** not accrescent, with 4 ovate or rounded lobes of *c.* 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 16741*, *S 27527*, *S 35773*, *S 36810*, *S 44264*, *S 45433*, *S 48368*, *S 52711*, *S 53439*, *S 53445*, and *S 53914*).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. graciliflora* is distinguished by the solitary flowers (and fruits) on filiform 0.7–2.5 cm long unbranched stalks, and the small round thin-walled fruits. The leaves vary from elliptic to rhombic. The small rhombic specimens are indistinguishable from *D. squamaefolia* by their leaves, but differ by the length of their stalks: 0.7–2.5 cm in *D. graciliflora*, 0.1–0.2 cm in *D. squamaefolia*. The two species are also geograpically separated, one in Sarawak and the other in Sabah. It differs from *D. densa* by its much smaller calyx lobes.

35. **Diospyros hallieri** Bakh. Fig. 2E.

(J.G. Hallier, 1868–1932, a German botanist)

Gard. Bull. S. S. 7 (1933) 172, *l.c.* (1938) 338; Masamune *l.c.* 603; Anderson *l.c.* 169; Beaman *et al. l.c.* 228. **Type:** *Hallier f. 2854*, Borneo, Kalimantan, Liang Gagang (holotype BO; isotype L).

Tree to 30 m tall. **Twigs** thick, reddish brown hairy when young, becoming glabrous with age, *rugose*, *warty-lenticellate*. **Leaves** chartaceous, glabrous, *not subglaucous below*; *oblong-elliptic* to *oblong-obovate*, *15–30(–38) × 5–11 cm*, *base cuneate* to slightly attenuate, *margin* *not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *8–15 pairs*, *diminishing toward leaf margin*; *intercostal venation very fine and scalariform-reticulate*, *with the veins spaced c. 0.2 cm apart*; *petiole c. 1 cm long*. **Male inflorescences** *c.* 1 cm long, each bearing about 10 flowers crowded at its extremity. **Male flowers** with *calyx divided into 4–5 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** 0.5–1.5 cm long, each bearing 3–6 flowers. **Female flowers** with *calyx divided into 4–5 valvate triangular lobes*. **Fruits** usually solitary, on 0.5–1.5 cm long stalks, depressed ovoid-globose, *c. 4 × 5 cm*, woody, apex depressed, glabrous, *shallowly ribbed*, symmetric. **Fruit calyx** *accrescent*, *rugose-woody*, *faintly veined*, *more or less flattened into a 4–5 pointed star-shaped plate of c. 3 cm diameter*, sometimes (but not always) with a woody pedestal under the plate, formed by the thickening of the calyx tube.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 21569*, *SAN 36421*, *SAN 59078*, *SAN 84992*, and *SAN 103486*), Sarawak (e.g., *S 16502*) and Kalimantan (e.g., *Endert 2588*, *Endert 2629*, *Kostermans 4833*, *Kostermans 5898*, and *Kostermans 13262*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The species is easily identified by its large oblong leaves with fine and closely spaced scalariform-reticulate intercostal venation. The leaves may resemble those of *D. perfida* but in *D. perfida*, the midrib tends to dry black; there is no such tendency in *D. hallieri*.

36. **Diospyros havilandii** Bakh. Fig. 6F.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Gard. Bull. S. S. 7 (1933) 172, *l.c.* (1937) 114; Masamune *l.c.* 603; Anderson *l.c.* 169. **Type:** *Haviland 2315*, Borneo, Sarawak, Kuching (holotype BO; isotypes L, SAR, SING).

Tree to 13 m tall. **Twigs** initially reddish brown tomentellous, later glabrous, *drying whitish*. **Leaves** coriaceous, glabrous, *glaucous below*, *with tendency to blacken above*; *elliptic*, 4–9 × 1.6–4 cm, base cuneate to slightly attenuate, apex acute to shortly acuminate; midrib sunken above; lateral veins faintly visible, 5–7 pairs, diminishing toward leaf margin; *intercostal venation invisible*; petiole *c.* 0.5 cm long. **Male inflorescences** slender, *c.* 1.4 cm long, each bearing 1–5 flowers. **Male flowers** with calyx divided almost to base into 4 small ovate imbricate lobes; corolla salverform, *c.* 1 cm long. **Female inflorescences** 0.2–0.8 cm long, each usually bearing solitary flower. **Female flowers** with calyx divided almost to base into 4 imbricate ovate lobes. **Fruits** solitary, ellipsoid or globose, to *c.* 1.6 cm diameter, without pointed apical protuberance, with thin brittle wall, smooth, glabrous, symmetric, on drying not shining black. **Fruit calyx** not accrescent, remaining small, *c.* 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 1825*, *S 2671*, *S 8068*, *S 20871*, and *S 27803*).

Ecology. In peat swamp forest.

Notes. This species is distinguished by its small leaves which are glaucous below, tending to blacken above, with almost invisible lateral veins and intercostal venation. In the past, specimens have been misplaced in the Euphorbiaceae, under *Glochidion* J.R. & G.Forst. and *Breynia* J.R. & G.Forst.

37. **Diospyros keningauensis** Ng Fig. 4A–J.

(of Keningau, Sabah)

Gard. Bull. Sing. 53 (2001) 297. **Type:** *Leopold & Saikeh SAN 74495*, Borneo, Sabah (holotype SING; isotypes KEP, SAN).

Tree to 40 m tall. **Leaves** chartaceous, *glabrous* to *sparsely appressed hairy below*, drying characteristically wrinkled; narrowly elliptic to ovate, 3.5–13 × 1.5–4 cm, *base cuneate* to *rounded*, apex acuminate; midrib prominulous above, appressed hairy when young; *lateral veins* prominent below, 5–8 pairs, *diminishing toward leaf margin*; *intercostal venation prominulous below*, *densely scalariform*; petiole 0.5–1 cm long. **Male inflorescences** 0.5–1.5 cm long, sometimes clustered in 2 or more to each node, each bearing 3–5 flowers. **Male flowers** with calyx divided into 4 valvate lobes; corolla salverform, *c.* 1.4 cm long. **Female inflorescences** 0.5–1 cm long, each usually bearing solitary flower. **Female flowers** with calyx divided into 4(–5) valvate lobes. **Fruits** solitary, *on 0.5–1 cm long stalks*, *globose*, *to c. 4.5 cm diameter*, irregularly wrinkled on drying, thick-walled, symmetric, densely hairy when young. **Fruit calyx** not accrescent; lobes about 0.5 × 0.5 cm.

Distribution. Endemic to Borneo and confined to Sabah (e.g., *Carr SFN 27136*, *SAN 26704*, *SAN 33783*, *SAN 71930*, and *SAN 74495*).

Ecology. In lower montane forest at 1300–1500 m altitude, in the vicinity of Mt. Kinabalu (Keningau, Ranau).

38. **Diospyros korthalsiana** Hiern Fig. 5H.

(P.W. Korthals, 1807–1892, a Dutch botanist)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 168; Merrill *l.c.* (1921) 484; Fischer *l.c.* 294; Bakhuizen *l.c.* (1938) 356; Masamune *l.c.* 604; Anderson *l.c.* 169; Coode *et al.* (eds.) *l.c.* 89; Argent *et al.* (eds.) *l.c.* 183; Ng *l.c.* (2001) 309; Beaman *et al. l.c.* 228. **Type:** *Korthals s.n.*, Borneo, Kalimantan (holotype L; isotype BO). **Synonyms:** *Maba myrmecocalyx* Hiern *l.c.* 139, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607; *D. myrmecocalyx* (Hiern) Bakh. *l.c.* (1933) 178, *l.c.* (1938) 359, *l.c.* (1955) plate 87; *D. bangueyensis* Merr. *l.c.* (1929) 247, Masamune *l.c.* 601.

Tree to 20 m tall. **Twigs** tending to dry whitish. **Leaves** chartaceous to coriaceous, glabrous, *tending to dry black on both sides*; *elliptic*, *5.5–13.5(–17) × 2.5–6(–9) cm*, *base broadly cuneate* or slightly attenuate, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous below*, *5–6 pairs*, *diminishing toward leaf margin*; *intercostal venation prominulous on both sides*, *reticulate*, *with reticulation stretched parallel to the lateral veins* (sometimes invisible); *petiole 0.4–1 cm long*, *drying black.* **Male inflorescences** 0.8–2.2 cm long, each bearing 1–7 flowers. **Male flowers** with *calyx a deep parallel-sided cup of 0.6–0.9 cm long*, *with 5 valvate teeth around rim*; corolla salverform, 1–1.5 cm long. **Female inflorescences** and

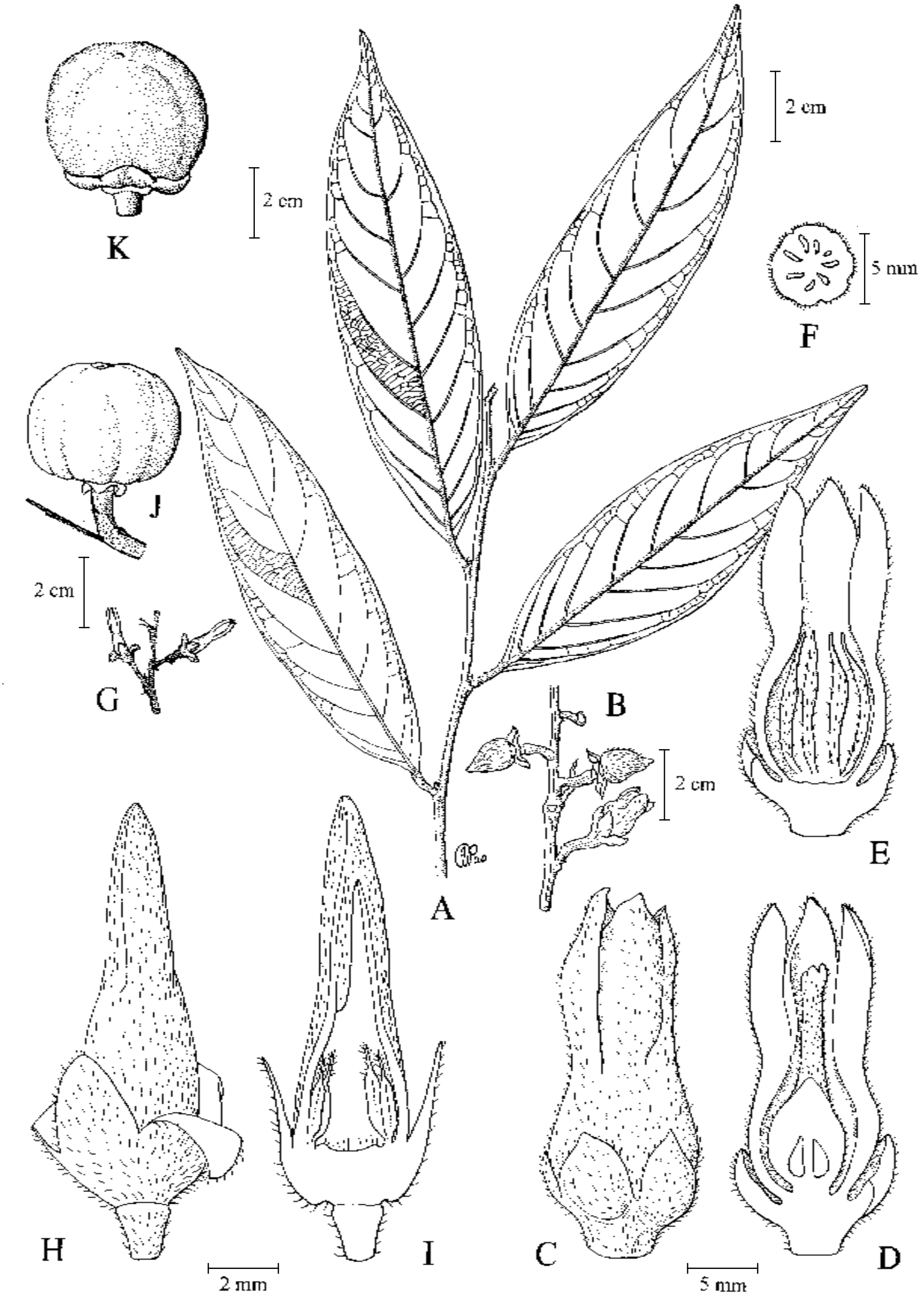

Fig. 4. *Diospyros keningauensis* (A–J); *D. areolata* (K). A, leafty twig; B, female inflorescence; C, female flower; D, famale flower in longitudinal section; E, as D but after removal of ovary to show staminodes; F, ovary in transverse section; G, male inflorescence; H, male flower bud; I, male flower bud in longitudinal section; J–K, fruits. (A–F from *SAN 26704*, G–I from *SFN 27136*, J from *SAN 74495*, K from *Coode 9644*.)

flowers unknown. **Fruits** *solitary*, *on 0.2–0.6 cm long stalk*, velvety when young, maturing glabrous, *oblong and c. 4 × 3.5 cm* or *depressed ovoid and c. 4 × 4.5 cm*, symmetric, *thick-walled*, *with pimply surface*, *not ribbed*, drying black. **Fruit calyx** *accrescent*, *divided into 4–5 triangular valvate lobes*, *initially cup-shaped*, *then becoming a shallow rugose-woody dish*, *c. 5.5 cm diameter*; *lobes stretched until the original lobing is almost obscured*, *faintly veined*.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *Chew et al. 243*, *SAN 72250*, *SAN 77627*, *SAN 82245*, and *SAN 107012*), Sarawak (e.g., *S 18942*, *S 24910*, *S 29102*, *S 29141*, *S 39180*, *S 45263*, and *S 61787*), Brunei (e.g., *Atkins 507*), and Kalimantan (e.g., *Kostermans 6934*).

Ecology. In lowland and hill mixed dipterocarp forests, to 1000 m altitude.

Notes. Bakhuizen divided this species into three varieties: var. *macrocarpa* (Korth.) Bakh. (which should properly be called var. *korthalsiana*) in Peninsular Malaysia, Borneo and Sulawesi; var. *mirandae* (Merr.) Bakh. in the Philippines; and var. *kinabaluensis* Bakh. in Sabah. In this treatment, no varieties are recognised. The sole specimen of this species from Peninsular Malaysia cited by Bakhuizen was *Henderson 23013*, but this was assigned by Bakhuizen a few pages later to *D. retrofracta* Bakh. The combination of black petiole and and whitish twigs is quite striking. Male flowers may be mistaken for those of *D. discocalyx* because of the similar calyx.

39. **Diospyros kurzii** Hiern

(W.S. Kurz, 1834–1878, Curator of the herbarium at Calcutta, India)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 162; Bakhuizen *l.c.* (1937) 173; Ng *l.c.* (1978) 76; Turner *l.c.* 198; Argent *et al.* (eds.) *l.c.* 162. **Type:** *Kurz s.n.*, Andamans (K).

Tree to 20 m, occassionally to 30 m tall. **Twigs** tending to dry black. **Leaves** membranaceous to chartaceous, drying wrinkled along lateral and intercostal veins, glabrous, *tending to dry black on both sides*; *elliptic*, *6–16 × 3–4.8 cm*, *base mostly slightly attennuate*, *sometimes cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous* to *prominent below*, *5–8 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation fine and faint*, *laxly reticulate*; *petiole 0.2–0.4 cm long*. **Male inflorescences** *0.2–0.5 cm long*, each bearing many small clustered flowers. **Male flowers** with *calyx small*, *divided into 4 valvate triangular lobes*; corolla ovoid in bud, *c.* 0.3 cm long. **Female inflorescences** *c. 0.5 cm long*, each bearing a few flowers. **Female flowers** with *calyx divided practically to base into 4 rounded valvate lobes*. **Fruits** 1–4 per cluster, on *c.* 0.5 cm long stalks, *ellipsoid*, *c. 1.2 × 0.9 cm*, *symmetric*, *not ribbed*, woody, glabrous. **Fruit calyx** not or slightly accrescent, *divided virtually to base into 4 leafy-coriaceous lobes that are reflexed backwards*, *each lobe about 0.5 × 0.4 cm.*

Distribution. Andamans, Thailand, Peninsular Malaysia, Borneo, the Philippines, and Maluku. In Borneo, known only from Sabah (e.g., *Nooteboom 1005*, *SAN 127582*, *SAN 30660*, *SAN 74397*, and *SAN 88380*).

Ecology. In lowland forests.

Notes. The Bornean specimens differ from those of Peninsular Malaysia in the fruits being glabrous instead of velvety. *D. kurzii* can be confused with *D. venosa.* In fruiting specimens of *D. venosa*, the calyx tube forms a distinct cup below the reflexed lobes, but such a cup is absent in *D. kurzii* because the lobes are divided to the base. The calyx in *D. kurzii* is always 4-lobed whereas that in *D. venosa* is often 3-lobed.

40. **Diospyros lanceifolia** Roxb.

(Latin, *lanceifolius* = with lance-shaped leaves)

Hort. Beng. (1814) 93, Fl. Ind., ed. Carey 2 (1832) 537; Bakhuizen *l.c.* (1938) 273; Anderson *l.c.* 169; Argent *et al.* (eds.) *l.c.* 183; Ng *l.c.* (1978) 76; Turner *l.c.* 198; Beaman *et al. l.c.* 228. **Type:** unknown.

Tree to 27 m tall. **Twigs** more or less reddish brown hairy when young, becoming glabrous with age, *drying blackish* or *dark brown*. **Leaves** *chartaceous* to *coriaceous*, *glabrous* or *sparsely* or *densely appressed hairy below*, *drying yellowish brown*, plane or bullate between veins; *narrow willow-like*, *elliptic*, *ovate*, *lanceolate*, *oblong-elliptic*, or *oblong-lanceolate*, *5.5–35 × 1–14 cm*, *base long-tapered*, *cuneate* or *rounded*, with or without a pair of pit-glands, *margin not undulate*, *apex long-tapered*, *acute* or *acuminate*; *midrib sunken above*; *lateral veins 5–24 pairs*, *prominulous* to *prominent below*, *diminishing toward leaf margin* or *inarching and forming pronounced intramarginal veins*; *intercostal venation invisible* or *visible on one or both sides of leaf*, *reticulate*, *laxly scalariform* to *reticulo-scalariform*; *petiole 0.6–2.4 cm long*. **Male inflorescences** 0.2–0.5 cm long, each bearing 3–10 crowded flowers. **Male flowers** with *calyx divided into 4 valvate triangular lobes*; corolla salverform, 0.6–1.2 cm long. **Female inflorescences** 0.1–0.3(–0.6) cm long, each bearing 1–7 flowers. **Female flowers** with *calyx divided into 4 valvate triangular lobes*. **Fruits** 1–3, subsessile or on stalks up to 0.6 cm long, *globose*, *1–2.5 cm diameter*, woody, *symmetric*, *not ribbed*, velvety hairy when young, glabrous with age. **Fruit calyx** slightly accrescent, woody, smooth, *with the tubular portion forming a cup to fit the base of fruit*; *lobes 0.5–1 × 0.4–1 cm*, *with erect or reflexed margins*, *veins faint* or *invisible*.

Distribution. India, Sumatra, Peninsular Malaysia, Borneo, and the Philippines.

Ecology. In lowland forests.

Notes. A highly variable species in which the extremes differ greatly from each other but are linked by intermediate forms. Five varieties are recognised in Sabah and Sarawak.

Key to varieties

1. Leaves glabrous or only scantily hairy below.......................................2
   Leaves hairy below...4

2. Leaves narrow, willow-like...
   var. **saliciformis** Ng
   (Latin, *saliciformis* = shaped like the willow, *Salix*)
   Gard. Bull. Sing. 53 (2001) 307. Type: *Coode 7826*, Borneo, Brunei (holotype KEP; isotype SING).

Tree to 20 m tall. Leaves chartaceous, *glabrous*, *narrowed*, *willow-like*, 5.5–11.5 × 1–3.2 cm, base gradually tapered and attenuate, without pit-glands, apex gradually tapered; lateral veins prominulous to almost invisible, 5–7 pairs; intercostal veins practically invisible below; petiole 0.3–0.5 cm long. Male and female inflorescences and flowers unknown. Fruits solitary, subsessile on 0.1–0.2 cm long stalks, to *c.* 1.5 cm diameter. Fruit calyx a 4 pointed star with the lobes up to 0.6 × 0.4 cm.

Endemic to Borneo and known from Sarawak (e.g., *Chew CWL 1170* and *S 49201*) and Brunei (e.g., *Coode 7826*). The leaves of *D. lanceifolia* var. *saliciformis* are superficially similar to those of *D. eucalyptifolia* and the narrow-leafed forms of *D. andamanica* and *D. ferruginescens*.

Leaves broader, lanceolate, oblong-elliptic, elliptic or ovate..........................3

3. Leaf base cuneate..

var. **lanceifolia**

Synonym: *D. lanceifolia* forma *typica* Bakh. *l.c.* (1938) 276.

Tree to 20 m tall. Leaves chartaceous, *glabrous* to *scantily hairy below*; *lanceolate* to *oblong-lanceolate*, rarely *elliptic*, *8–17 × 2.5–5.5 cm*, *base cuneate*, apex acuminate; lateral veins prominulous to prominent below, 6–9 pairs; intercostal venation invisible to prominulous below, vaguely scalariform to vaguely reticulate; petiole 0.6–1.5 cm long. Female inflorescences *c.* 0.1 cm long, each bearing 1–3 flowers. Fruits mostly solitary, subsessile, on *c.* 0.1 cm stalks, to *c.* 1.3 cm diameter. Fruit calyx with lobes *c.* 0.5 × 0.5 cm.

India, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (e.g., *SAN 61442*, *SAN 77588*, *SAN 93823*, and *SAN 99625*), Sarawak (e.g., *S 13428*, *S 37680* and *S 42109*), Brunei (e.g., *SAN 13137*), and Kalimantan (e.g., *Anderson 14* and *Mahyar et al. 1297*). In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Leaf base rounded..

var. **renageorgei** Ng

(Rena George, 1956–1994, former officer-in-charge of the Semengoh Botanical Research Centre, Sarawak)

Gard. Bull. Sing. 53 (2001) 306. Type: *Rena George S 43068*, Borneo, Sarawak, Limbang (holotype KEP).

Tree to 21 m tall. Leaves chartaceous, *glabrous*, usually shiny on upper surface and sometimes also on lower surface, slightly bullate between veins; *elliptic* to *ovate*, *6–19.5 × 4–8.5 cm*, *base rounded*, slightly attenuate, and often bearing a pair of pit-glands, apex acuminate; lateral veins sunken above, prominent below, 6–12 pairs; intercostal venation sunken above, prominulous below, reticulo-scalariform; petiole 0.8–1.5 cm long. Female inflorescences up to 0.6 cm long, each bearing 1–5 flowers. Fruits about 3, on 0.3–0.6 cm long stalks, *c.* 1.3 cm diameter. Fruit calyx with lobes to 1 × 1 cm.

Endemic to Borneo and known from Sabah (e.g., *SAN 99668*), Sarawak (e.g., *S 17862*, *S 17897*, *S 42254*, *S 43068*, and *S 47134*) and Brunei (e.g., *Coode 7050*). In lowland mixed dipterocarp forest.

4. Lateral veins inarching near leaf margin but the inarches not prominent enough to rate as an intramarginal veins..

var. **consanguinea** (Merr.) Masamune

(Latin, *consanguineus* = akin; a species closely resembling *D. maritima*)

EPB (1942) 604. Basionym: *D. consanguinea* Merr. *l.c.* (1929) 244, Coode *et al.* (eds.) *l.c.* 88. Type: *Elmer 20626*, Borneo, Sabah, Tawau (SING). Synonym: *D. lanceifolia* forma *consanguinea* (Merr.) Bakh. *l.c.* (1938) 276.

Tree to 20 m tall. Leaves chartaceous to coriaceous, *hairy below*; oblong-elliptic to lanceolate, 8–15(–22) × 2.5–6(–8) cm, base cuneate to rounded, apex acuminate; *lateral veins c. 10 pairs*; sunken above, *inarching near margin but not forming distinct intramarginal veins*, prominent below, intercostal venation sunken above, prominent below, vaguely scalariform; petiole 0.8–1.2 cm long. Female inflorescences 0.1–0.3 cm long, each bearing 1–3 flowers. Fruits mostly solitary, on 0.1–0.3 cm long stalks, to *c.* 1.5 cm diameter. Fruit calyx lobes about 0.5 × 0.5 cm.

Sumatra and Borneo. In Borneo, known from Sabah (common, e.g., *Elmer 20626*, *SAN 34133*, *SAN 40126*, *SAN 55848*, *SAN 96393*, and *SAN 116669*), Sarawak (e.g., *S 32328*, *S 32332*, *S 37491*, and *S 38311*), Brunei (e.g., *Dransfield JD 7412* and *Wong WKM 264*), and Kalimantan (e.g., *Kostermans 10685* and *McDonald & Ismail 3472*).

The type is actually less hairy than the majority of specimens subsequently collected, so it forms a bridge between the glabrous var. *lanceifolia* and hairy var. *consanguinea*. Kostermans (1977) has proposed to restore var. *consanguinea* to species status because of the strong intramaginal vein development in some specimens. However, the type specimen itself does not have strong intramarginal vein development. In the present account, the specimens with strong intramarginal veins are placed under a separate variety, var. *iliaspaiei*, as described below.

Lateral veins linked up on each side by a prominent intramarginal vein…………………..

var. **iliaspaiei** Ng

(Ilias Paie, 1936–1986, plant collector of the Sarawak Forestry Department)

Gard. Bull. Sing. 53 (2001) 305. Type: *Ilias S 50180*, Borneo, Sarawak (holotype SAR).

Tree to 27 m tall. Twigs densely rusty hairy. Leaves coriaceous, *densely rusty hairy below*, bullate between veins; oblong-lanceolate, 13.5–35 × 3.5–14 cm, base cuneate to rounded, sometimes bearing a pair of pit-glands, apex acuminate to acute; *lateral veins* prominent below, sunken above, 15–24 pairs, *inarching and joining near leaf margin to form a prominent intramarginal vein*; intercostal venation prominent below, sunken above, reticulo-scalariform; petiole 1–2.4 cm long. Female inflorescences 0.2–0.5 cm long, each bearing *c.* 3 flowers. Fruits 1–3, on 0.2–0.5 cm long stalks, globose, to *c.* 2 cm diameter, shiny black. Fruit calyx with lobes *c.* 1 × 0.8 cm.

Endemic to Borneo and confined to Sarawak (e.g., *S 24803*, *S 39109*, *S 41224*, *S 50180*, and *Zainuddin 5671*). In lowland mixed dipterocarp forest.

41. **Diospyros lateralis** Hiern Fig. 5I.

(Latin, *lateralis* = lateral; alluding the lateral position of the inflorescences on the stem)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 167; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 352; Masamune *l.c.* 604; Ng *l.c.* (2001) 310. **Type:** *Beccari PB 1600*, Borneo, Sarawak (K). **Synonym:** *D. crassipes* Bakh. *l.c.* (1933) 167, *l.c.* (1938) 290.

Tree to 17 m tall. **Twigs** *glabrous*. **Leaves** chartaceous, *glabrous*; oblong-elliptic, 9.5–12 × 3.2–4.6 cm, *base cuneate*, apex acuminate; midrib sunken above; *lateral veins* prominent below, 4–6 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous*, *closely* *scalariform and running at right angles to midrib*; petiole 0.2–0.8 cm long. **Male inflorescence** 0.5–1 cm long, each bearing *c.* 3 flowers. **Male flowers** with calyx deeply cup-shaped, divided at top into 5 small triangular teeth. **Female inflorescences** and **flowers** unknown. **Fruits** *solitary*, *subsessile* (*stalks 0.1–0.2 cm long*), *globose* to *depressed ovoid*, *to c. 2.6 cm diameter*, when dry vertically ribbed according to the number of seeds contained within, woody. **Fruit calyx** accrescent, rugose, woody, forming a shallow cup with 5 teeth around the rim.

Distribution. Thailand, Sumatra and Borneo. In Borneo, known from Sarawak only; a rare tree represented by its type (*Beccari PB 1600*) and two other specimens (*Beccari PB 2041*, type of *D. crassipes*, and *S 5367*).

Ecology. In lowland mixed dipterocarp forest.

42. **Diospyros lunduensis** Ng Fig. 5A–F.

(of Lundu, Sarawak)

Gard. Bull. Sing. 53 (2001) 299. **Type:** *Othman S 49996*, Borneo, Sarawak, Lundu, G. Pueh (holotype KEP; isotype SAR).

Tree to 25 m tall. **Twigs** *covered with short appressed hairs*. **Leaves** coriaceous, glabrous, tending to dry black above, *not subglaucous below*; *elliptic* to *oblong-elliptic*, *5.6–14 × 2.8–6 cm*, *base rounded* to *subcordate*, *margin not undulate*, *apex shortly acuminate* or *acute*; *midrib sunken above*; *lateral veins prominent below*, *5–7 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation* prominent below, *laxly reticulate*; *petiole 0.5–0.8 cm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** 0.2–0.4 cm long, each bearing usually solitary flower. **Female flowers** with *calyx deeply divided into 4 rounded imbricate hairy lobes*, sometimes notched at apex. **Fruits** solitary, on 0.2–0.4 cm long stalks, globose, *to c. 2 cm diameter*, *glabrous* to *sparsely appressed hairy*, *not ribbed*, smooth, symmetric. **Fruit calyx** *not accrescent*; *lobes to 0.6 × 0.6 cm*, *spreading* to *reflexed*.

Distribution. Endemic to Borneo and known from Sarawak (e.g., *S 25482*, *S 49996*, and *S 59692*) and Brunei (e.g., *BRUN 18266* and *Ogata et al. OG-B 507*).

43. **Diospyros macrophylla** Blume Fig. 2F.

(Greek, *makro* = large, *phullon* = leaf; large-leafed)

Bijdr. Fl. Ned. Ind. (1825) 670; Bakhuizen *l.c.* (1938) 342; Argent *et al.* (eds.) *l.c.* 184. **Type:** *Blume s.n.*, Java, G. Parang (holotype L). **Synonyms:** *D. suluensis* Merr. *l.c.* (1926) 422, *l.c.* (1929) 240, Masamune *l.c.* 606; *D. pachycalyx* Merr. *l.c.* (1929) 246, Masamune *l.c.* 605.

Tree to 30 m tall. **Twigs** velvety in young parts, becoming glabrous with age. **Leaves** chartaceous, *not bullate between veins*, *finely velvety on midrib and lateral veins below* to *almost glabrous*, *tending to dry black above* or *on both sides*; *elliptic* or *oblong-elliptic*, *8–18 × 3–7 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *7–13 pairs*, *diminishing toward leaf margin*; *intercostal venation very fine*

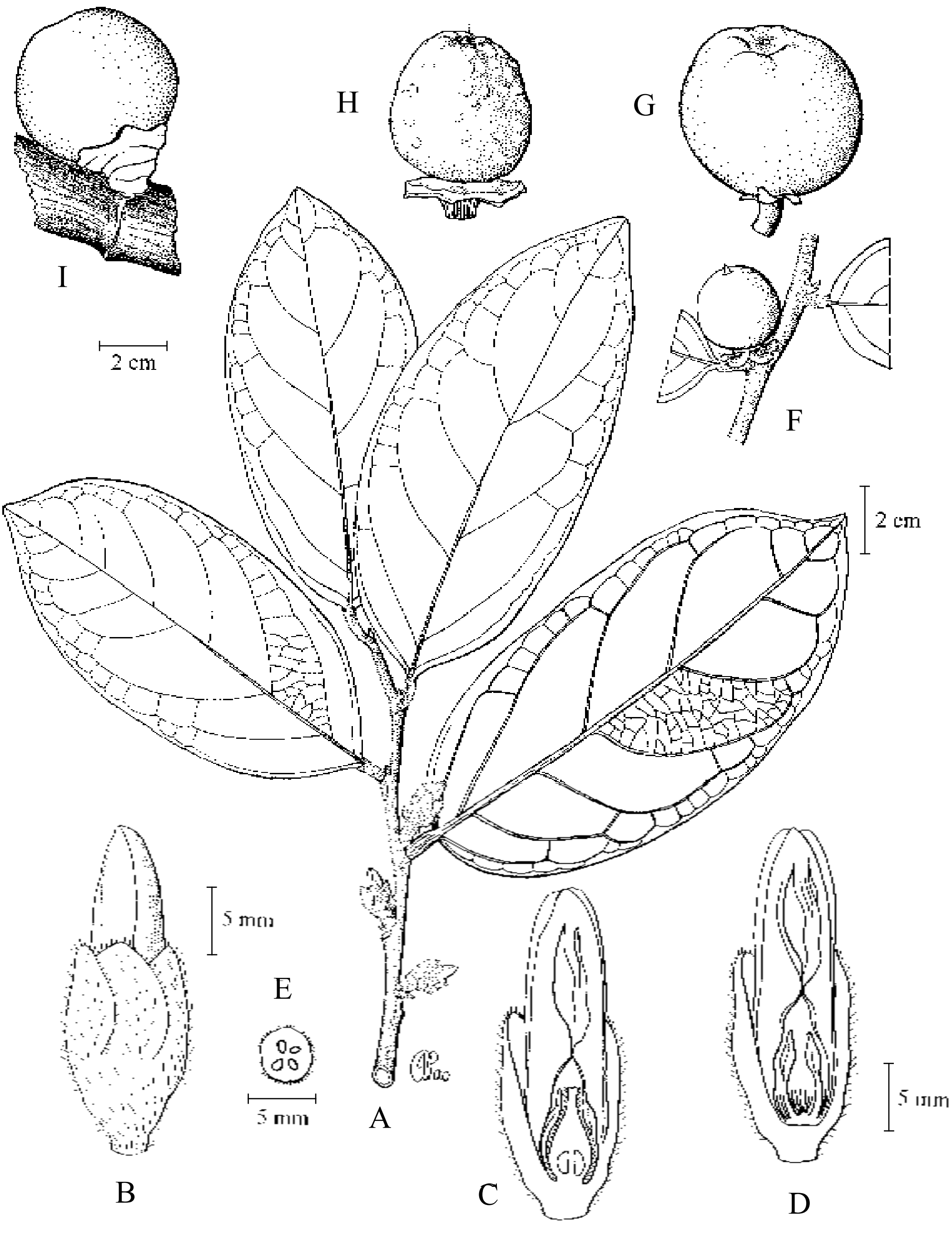

Fig. 5. *Diospyros lunduensis* (A–F); *D. daemona* (G); *D. korthalsiana* (H); *D. lateralis* (I). A, flowering leafy twig; B, female flower bud; C, female flower bud in longitudinal section; D, as C but with ovary removed to show staminodes; E, ovary in transverse section; F–I, fruits. (A–E from *S 25482*, F from *S 49996*, G from *SAN 85013*, H from *SAN 43100*, I from *S 5367*.)

and prominulous below, *scalariform as well as reticulate*; *petiole 0.3–0.5 cm long*. **Male inflorescences** 0.5–2 cm long, each bearing 3–20 flowers. **Male flowers** with *calyx tubular*, *divided at top into 4–5 small teeth*; corolla salverform, to *c.* 0.8 cm long. **Female inflorescences** 0.5–4 cm long, each bearing 1–5 flowers. **Female flowers** with *calyx divided deeply into 4–5 plicate-triangular valvate lobes*; pedicels sometimes conspicuously black-hairy. **Fruits** 1–4, on stout stalks of 0.5–4 cm long, *velvety when young*, *maturing glabrous*, globose to oblong, to *c. 6.5 × 5.5 cm*, *not ribbed*, smooth or sometimes shallowly longitudinally puckered; pulp edible. **Fruit calyx** *accrescent*, *stretched into a 4–5 sided woody plate with narrow reflexed margins*, *either 3–4 cm diameter and not extending beyond the periphery of the fruit*, or *massively enlarged to 8 cm diameter and extending beyond the periphery of the fruit*, *veins very faint* or *invisible*.

Distribution. Sumatra, Java, Borneo, Sulawesi, and the Philippines. In Borneo, known from Sabah (very common; e.g., *SAN 17712*, *SAN 34272*, *SAN 57664*, *SAN 75156*, and *SAN 109328*), Sarawak (e.g., *S 31532*, *S 31739*, *S 32171*, and *S 39352*) and Kalimantan (e.g., *Burley & Lee 279*, *Kostermans 4840*, *Kostermans 6927*, and *Kostermans 9537*).

Ecology. In lowland and hill mixed dipterocarp forest, to 1000 m altitude.

Notes. *D. macrophylla* is very variable in the degree of hairiness of the leaves (finely velvety below to glabrous), the size of the fruiting calyx (4–8 cm diameter) and the form of the female inflorescence. Male inflorescences may be mistaken for those of *D. pilosanthera*.

44. **Diospyros maingayi** (Hiern) Bakh.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Gard. Bull. S. S. 7 (1933) 164, *l.c.* (1937) 94; Ng *l.c.* (1978) 77; Anderson *l.c.* 169; Turner *l.c.* 198; Argent *et al.* (eds.) *l.c.* 184. **Basionym:** *Maba maingayi* Hiern *l.c.* 138, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Maingay 976*, Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Maba motleyi* Hiern *l.c.* 139, *p.p.*, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607.

Tree to 30 m tall or more. **Twigs** *drying black.* **Leaves** coriaceous, glabrous to velvety below, *drying consistently black on both sides*; *elliptic*, *8–20 × 5–11 cm*, base rounded or broadly cuneate, apex rounded, retuse or shortly acuminate; midrib sunken above; lateral veins prominulous, 5–9 pairs, faintly inarching and joining to form intramarginal vein-loops near leaf margin; *intercostal venation invisible*; petiole 1.5–2 cm long. **Male inflorescences** 0.5–1.2 cm long, often in axillary clusters of up to 4 per node, each bearing a solitary flower. **Male flowers** with calyx divided into 4–5 semi-circular lobes. **Female inflorescences** 1–1.5 cm long, each bearing 2–4 flowers. **Female flowers** resembling male except more bulging at base. **Fruits** in clusters of 2–4, on 1–1.5 cm long stalks, oblong-ellipsoid, to *c.* 5 × 3.5 cm, drying woody, smooth and glabrous. **Fruit calyx** not accrescent; lobes spreading, rounded, *c.* 0.5 × 0.4 cm.

Vernacular name. Sarawak—*merpinang daun besar* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 57592*, *SAN 80001*, *SAN 80005*, *SAN 80006*, and *SAN 80028*), Sarawak (common, e.g., *Carroll 229*, *Hewitt 1039*, *KEP 79320*, *S 12421*, *S 29384*, and *S 40434*), Brunei (e.g., *Sinclair & Kassim 10505*), and Kalimantan (e.g., *bb. 26094*, *Kostermans 4197*, *Kostermans 6077*, *Kostermans 7736*, *Kostermans 10072*, and *Kostermans 10365*).

Ecology. Mostly in peat swamp forest, but also in non-swampy lowland forests.

Notes. Close to *D. evena* and *D. puncticulosa* in the way the leaves and twigs drying black, the imbricate non-accrescent fruit calyx and the almost invisible intercostal venation, but the leaves and fruits are larger.

45. **Diospyros maritima** Blume

(Latin, *maritimus* = growing by the sea)

Bijdr. Fl. Ned. Ind. (1825) 669; Fischer *l.c.* 294; Bakhuizen *l.c.* (1938) 265; Masamune *l.c.* 604. **Type:** *Blume s.n.*, Java (*n.v.*).

Tree to 15 m tall. **Leaves** chartaceous, glabrous, *not subglaucous below*; *oblong-elliptic* to *elliptic*, *7–21 × 3–7 cm*, *base cuneate* to *rounded*, *margin somewhat undulate*, *apex acute* to *rounded*; *midrib sunken above*; *lateral veins prominulous*, *6–10 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation faint on both sides*, *laxly reticulate*; *petiole 0.8–1 cm long*. **Male inflorescences** 0.1–0.2 cm long, each bearing to 10 flowers. **Male flowers** with calyx divided in the upper quarter into 4 small valvate triangular lobes; corolla salverform, *c.* 0.7 cm long. **Female inflorescences** and **flowers** unknown. **Fruits** solitary, subsessile, globose, *to c. 1.7 cm diameter*, *not ribbed*, thinly woody, velvety when young, smooth and symmetric. **Fruit calyx** *accrescent*, *forming a 4-pointed cup.*

Distribution. Sumatra, Java, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. In Borneo, known from Sabah (locally common on Pulau Balambangan, Pulau Tiga and Pulau Mengalon, e.g., *SAN 26599*, *SAN 84740*, *SAN 103157*, *SAN 126022*, and *SAN 127152*) and Brunei (*Wong & Kamariah 4*).

Ecology. In coastal forests.

Notes. The flowers and fruits remind those of *D. lanceifolia* but the leaves are characteristically elliptic, with rounded to acute apices (unusual in a genus in which most species have acuminate apices), and usually undulate leaf margin.

46. **Diospyros mindanaensis** Merr.

(of Mindanao, the Philippines)

Philip. J. Sci. 4 (1909) 309; Bakhuizen *l.c.* (1938) 349; Anderson *l.c.* 169; Coode *et al.* (eds.) *l.c.* 89 (including *D. aff. mindaenaensis* and *D. mindanaensis vel aff.*); Ng *l.c.* (2001) 310; Beaman *et al. l.c.* 228. **Syntypes:** *Whitford FB 9019* and *Hutchinson FB 4811*, the Philippines (*n.v.*). **Synonym:** *D. endertii* Bakh. *l.c.* (1933) 169, *l.c.* (1938) 365, Masamune *l.c.* 602.

Tree to 27 m tall. **Twigs** glabrous, sparsely lenticellate, rugose, drying blackish. **Leaves** chartaceous to coriaceous, *not bullate between veins*, *glabrous*, *upper surface dull*, *lower surface* *not subglaucous*; *oblong*, *8.5–37 × 3.5–10 cm*, *base cuneate*, *rounded* or *subcordate*, *margin not undulate*, *apex acuminate*; *midrib variably sunken*, *flat* or *prominent above*; *lateral veins prominent below*, *5–14 pairs*, *diminishing toward leaf margin*; *intercostal venation prominulous above and below*, *reticulate*; *petiole 0.7–3 cm long*. **Male inflorescences** 1.3–3.5 cm long, each bearing 3 or more flowers, sometimes appearing as a large pseudo-panicle formed by the suppression of leaves on the flower-bearing shoots. **Male flowers** with *calyx cup-shaped*, *with the opening truncate* or *shallowly 4–5 toothed*; corolla urceolate. **Female inflorescences** 0.3–3.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4–5 valvate lobes*, sharply reflexed at a position halfway up the tube, reflexed part spreading horizontally or bent backwards. **Fruits** usually solitary, on 0.3–3.5 cm long stalks, globose, depressed globose or ovoid-globose, *to c. 7.5 cm diameter*, symmetric, *not ribbed*, *woody thick-walled*, *glabrous*. **Fruit calyx** *1.5–2.5 × 3–5 cm*, *erect* to *reflexed*, *with the base of calyx tube greatly thickened* or *not*, *not distinctly cup-shaped*; *lobes greatly expanded* or *not*, coriaceous to hard and brittle, *veins very faint or invisible*.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (common, e.g., *Clemens 30359*, *Kokawa & Hotta 1492*, *SAN 24548*, *SAN 70209*, and *SAN 132635*), Sarawak (common, e.g., *Jacobs 5097*, *S 13184*, *S 37510*, *S 39094*, and *S 47320*), Brunei (e.g., *Dransfield JD 7277*, *Hotta 12812*, *S 10959*, and *Simpson 2454*), and Kalimantan (e.g., *Burley 2704*, *Burley et al. 2491*, *Endert 4017*, and *Partomihardjo 1142*).

Notes. This species is distinguished by its large oblong leaves and large fruits. The form of the fruit calyx is extremely variable. In general, the calyx is reflexed sharply from a position about halfway up the calyx tube. The lobes themselves may or may not be bent back in the opposite direction. Also, the basal (non-reflexed) part of the calyx tube may be greatly thickened or not. These variations are not correlated with any differences in leaf morphology. Male specimens are few in comparison with female specimens, but the male specimens are consistent and provide no basis for recognition of more than one species. It is not even possible to divide the species into varieties. *D. rigida* differs in having longer, more rigid leaves, which dry with a yellowish tinge on the underside, and its intercostal venation is finer.

47. **Diospyros muricata** Bakh. Fig. 6G.

(Latin, *muricatus* = rough with short hard points; alluding the bristly hairy fruits)

Gard. Bull. S. S. 7 (1933) 177; Bakhuizen *l.c.* (1937) 164; Masamune *l.c.* 604; Anderson *l.c.* 169. **Syntypes:** *Jaheri 644*, Borneo, Kalimantan (BO) and *Haviland & Hose 3483*, Borneo, Sarawak (SAR).

Tree to 11 m tall. **Twigs** *covered with short appressed hairs*. **Leaves** chartaceous, glabrous or hairy on veins, tending to dry black above, *not subglaucous below*; *obovate* or *elliptic*, *11–21 × 3.5–7.5 cm*, *base cordate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib prominent above*; *lateral veins prominent below*, *6–10 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *reticulate* to *laxly scalariform*; *petiole c. 0.5 cm long*. **Male inflorescences** 0.1–0.5 cm long, each bearing 3–7 closely clustered flowers. **Male flowers** with *calyx divided deeply into 4 imbricate ovate lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** *0.1–0.3 cm long*, each bearing about 3 flowers. **Female flowers** with *calyx divided* *into 4 imbricate rounded lobes*. **Fruits** 1–3, subsessile on 0.1–0.3 cm long stalks, ovoid, *to c. 2 cm diameter*, *covered with bristly*, *appressed* or *somewhat spreading hairs*, *not ribbed*, faintly wrinkled, symmetric. **Fruit calyx** *not accrescent*; *lobes c. 0.3 × 0.2 cm*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 34099*, *SAN 93111* and *SAN 120973*), Sarawak (e.g., *Haviland & Hose 3483* and *S 16438*), Brunei (e.g., *Dransfield JD 6874*), and Kalimantan (e.g., *Jaheri 644*).

Ecology. In lowland mixed dipterocarp forest, to 330 m altitude.

Notes. The leaves with subcordate to rounded base, tending to dry black above, and the bristly hairs on the fruits are diagnostic. The midrib, lateral and intercostal veins raised instead of sunken above distinguishes *D. muricata* from *D. everettii*.

48. **Diospyros neurosepala** Bakh. Fig. 1F.

(Greek, *neuron* = sinew or nerve, *sepalum* = sepal; alluding the prominently veined fruit calyx)

Gard. Bull. S. S. 7 (1933) 178, *l.c.* (1938) 181; Masamune *l.c.* 604; Anderson *l.c.* 169. **Type:** *Beccari PB 541*, Borneo, Sarawak (K, photo).

Tree to 13 m tall. **Leaves** chartaceous, *glabrous*, more or less bullate between veins, drying with a yellow tinge; elliptic to oblong-elliptic, 8–22 × 2.5–6 cm, base rounded to cuneate, apex acuminate; midrib sunken above; *lateral veins* 5–8 pairs, *sunken above*, prominent below, *inarching and joining to form intramarginal vein at one third of the distance from leaf margin to midrib*; *intercostal venation sunken above*, *prominent below*, *laxly reticulate*; petiole 0.7–1.5 cm long. **Male inflorescences** *c.* 2 cm long, each bearing about 6 flowers. **Female inflorescences** and **flowers** unknown. **Fruits** solitary, *on 0.8–1.3 cm long bracteate stalks*, globose, to *c*. 4.5 cm diameter, glabrous, symmetric, drying smooth to somewhat puckered. **Fruit calyx** *divided into 4 valvate leafy coriaceous*, *prominently veined*, *erect spreading lobes of c. 2.5 × 2.5 cm*.

Distribution. Endemic to Borneo and known from Sarawak (e.g., *S 13370*, *S 13393*, *S 17036*, *S 34326*, *S 35736*, and *Sinclair & Kassim 10226*) and Kalimantan (e.g., *Church et al. 1654*).

Notes. This species stands out by the midrib, lateral and intercostal veins sunken above, the inarching of the lateral veins at a wide distance from the leaf margins, and the leafy, veined fruit calyx lobes.

49. **Diospyros oligantha** Merr. Fig. 6H.

(Greek, *oligos* = few, *anthos* = flower; the few-flowered inflorescence)

PEB (1929) 243; Bakhuizen *l.c.* (1937) 118; Masamune *l.c.* 604. **Type:** *Elmer 21419*, Borneo, Sabah, Tawau (BO, L, SING).

Tree to 30 m tall. **Twigs** glabrous to densely hairy. **Leaves** chartaceous, glabrous to densely hairy and *not subglaucous below*; *obovate*, *elliptic* or *ovate*, *4–18 × 2–7 cm*, *base cuneate*, rarely rounded, *margin not undulate*, *apex acuminate*; *midrib sunken above*, *forming a groove that is often filled with hairs*; *lateral veins prominent below*, *4–6 pairs*, *diminishing toward leaf margin*; *intercostal venation prominulous below*, *weakly scalariform* to *reticulate*; *petiole 0.3–0.9 cm long*. **Male inflorescences** *0.1–0.8 cm long*, each bearing 3–10 flowers. **Male flowers** with *calyx divided into 4 imbricate rounded lobes*; corolla 0.5–0.8 cm long, salverform. **Female inflorescences** *0.1–1 cm long*, each bearing 3–5 flowers. **Female flowers** with *calyx divided into 4 imbricate rounded lobes*. **Fruits** 1–5, on stalks of 0.1–0.5 cm long (rarely up to 1 cm long, in which case the individual pedicels do not exceed 0.5 cm), *globose*, *to c. 1.9 cm diameter*, *not ribbed*, symmetric, *glabrous* to *sparsely appressed hairy*, puckered on drying. **Fruit calyx** *not accrescent*; *lobes c. 0.2 × 0.2 cm*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *Elmer 20592*, *FMS 36824*, *SAN 25001*, *SAN 97125*, and *SAN 109820*), Sarawak (e.g., *S 0895*, *S 16622* and *S 23893*) and Brunei (e.g., *FMS 48207*).

Notes. Until this revision, *D. oligantha* was only a name attached to the type specimens, of which there were no duplicates in Sabah. It turns out to be a very common species in Sabah, bearing a close resemblance to *D. clavigera* of Peninsular Malaysia. It differs from *D. simaloerensis* in the fruits sparsely appressed hairy or glabrous instead of densely velvety, and the pedicels less than 0.5 cm long. It differs from *D. fusiformis* by its shorter inflorescences and globose fruits. Its fruits resemble those of *D. subrhomboidea*.

50. **Diospyros parabuxifolia** Ng Fig. 6A–B.

(Greek, *para* = near/similar to; near to *D. buxifolia*)

Gard. Bull. Sing. 53 (2001) 301. **Type:** *Ilias S 33017*, Borneo, Sarawak, Lawas, Bt. Batanga (holotype KEP; isotype SAR).

Tree to 15 m tall. **Twigs** *on drying not consistently black*. **Leaves** chartaceous, glabrous, *not glaucous below*, *on drying not consistently black*; *obovate*, *1.5–2 × 0.8–1.5 cm*, base cuneate to attenuate, *apex rounded*, *acute* or *shortly acuminate*; midrib sunken to raised above; lateral veins invisible; *intercostal venation invisible*; petiole 0.1–0.2 cm long. **Male** and **female inflorescences** and **flowers** unknown. **Fruits** solitary, *on elongated 1.5–2 cm long stalks*, *ellipsoid*, *c.* 2 × 1 cm, symmetric, thin-walled, puckered on drying, almost glabrous. **Fruit calyx** not accrescent, divided deeply into 4 imbricate rounded lobes *c.* 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 33017* and *S 60062*).

Ecology. In lower montane forest at 1000–1500 m altitude.

Notes. This species differs from *D. buxifolia* mainly by its elongated fruit stalk. From *D. graciliflora*, which also has an elongated fruit stalk, it differs in the fruit ellipsoid instead of globose. Also the fruit stalk in *D. graciliflora* is much more slender.

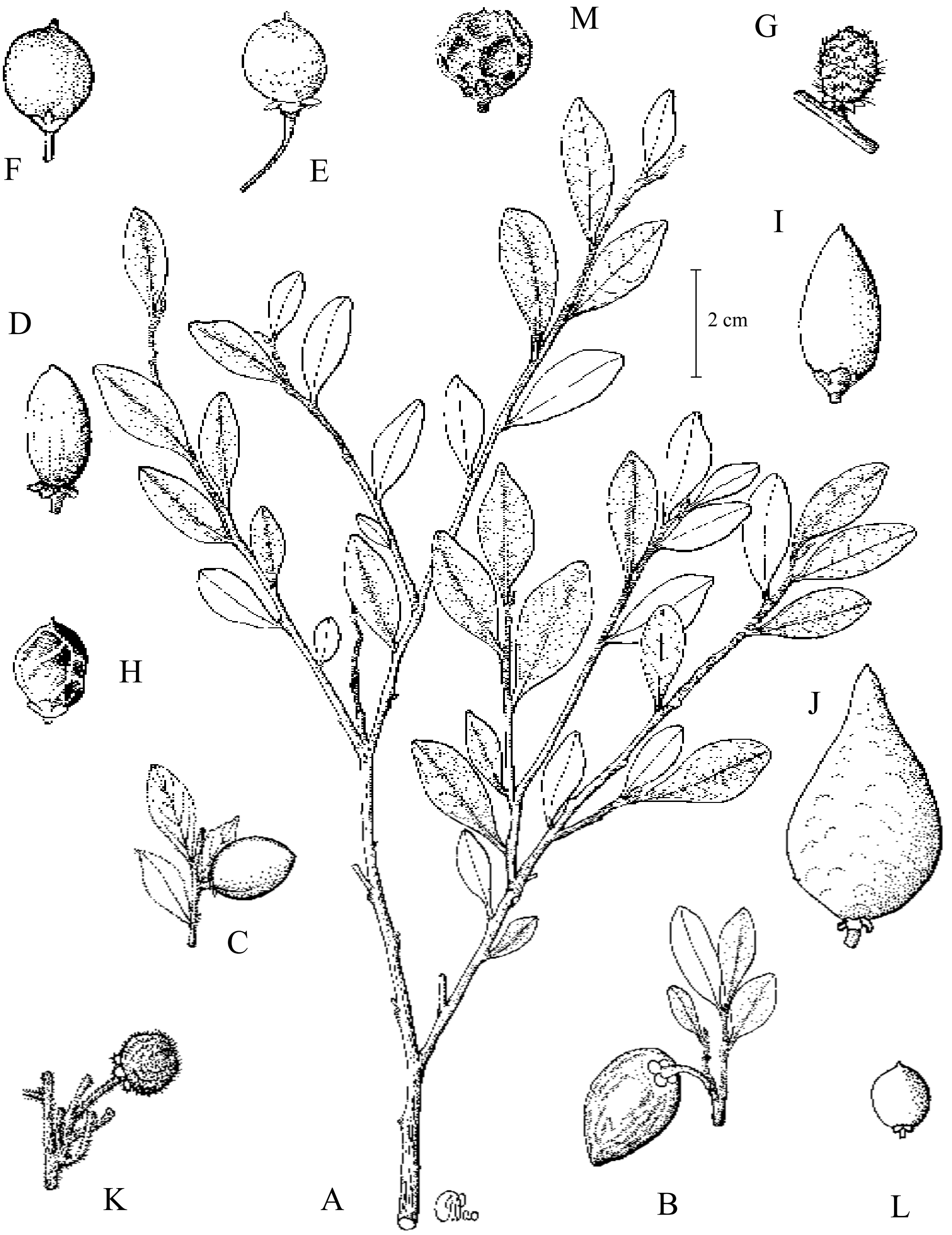

Fig. 6. *Diospyros parabuxifolia* (A–B); *D. buxifolia* (C); *D. evena* (D); *D. graciliflora* (E); *D. havilandii* (F); *D. muricata* (G); *D. oligantha* (H); *D. plectosepala* (I); *D. puncticulosa* (J); *D. simaloerensis* (K); *D squamaefolia* (L); *D. subrhomboidea* (M). A, leafy twig; B–C, fruiting leafy twigs; D–M, fruits. (A–B from *S 33017*, C from *SAN 94300*, D from *SAN 84289*, E from *S 27527*, F from *S 27803*, G from *SAN 93111*, H from *SAN 61533*, I from *S 44205*, J from *S 48377*, K from *S 23775*, L from *SAN 93630*, M from *S 41141*.)

51. **Diospyros pendula** Hasselt *ex* Hassk.

(Latin, *pendulus* = pendent; referring to the inflorescence)

Pl. Jav. Rar. Descr. (1848) 468; Bakhuizen *l.c.* (1938) 295; Masamune *l.c.* 605; Ng *l.c.* (1978) 80; Anderson *l.c.* 170; Turner *l.c.* 199; Coode *et al.* (eds.) *l.c.* 89; Beaman *et al. l.c.* 229. **Type:** unknown. **Synonym:** *D. fuliginea* Hiern *l.c.* 184, Merrill *l.c.* (1921) 484, Masamune *l.c.* 603.

Tree to 20 m tall. **Twigs** *glabrous*, *on drying not black*. **Leaves** chartaceous to coriaceous, *glabrous*, smooth on both sides, *drying pale brown on both sides*; *oblong*, *oblong-elliptic*, or *oblong-obovate*, *7–25 × 2.5–8 cm*, base cuneate to rounded, apex acute to acuminate; midrib sunken above; *lateral veins* prominulous below, *7–9 pairs*, diminishing toward leaf margin; *intercostal venation invisible on both sides*; petiole 0.7–1.3 cm long. **Male inflorescences** slender, 0.3–4 cm long, each bearing 3 or more flowers. **Male flowers** with calyx divided into 4 valvate lobes, but in the young buds appearing globose or ellipsoid with a small opening at top; corolla salverform, *c.* 1 cm long. **Female inflorescences** stout, 0.3–2.5 cm long, each bearing usually 1, rarely 3 flowers. **Female flowers** with calyx divided halfway into 4 triangular valvate lobes. **Fruits** usually solitary (rarely up to 3), on stalks of 0.3–2.5 cm long, ovoid to depressed globose, to *c.* 3 × 3.5 cm, woody, glabrous, symmetric, with pimply surface when dry. **Fruit calyx** slightly accrescent, more-or-less flattened into a 4-pointed woody star to *c.* 2 cm diameter.

Distribution. Myanmar, Thailand, Peninsular Malaysia, Borneo, and Java. In Borneo, known from Sabah (common, e.g., *SAN 32170*, *SAN 41346*, *SAN 75975*, *SAN 78422*, and *SAN 127019*), Sarawak (e.g., *Hansen 840*, *Jacobs 5449*, *S 33140*, *S 40769*, and *S 43884*), Brunei (e.g., *SAN 17405*), and Kalimantan (e.g., *Church & Mahyar 1868*, *Kessler et al. 860* and *Kostermans 13849*).

Ecology. In lowland mixed dipterocarp forest.

52. **Diospyros penibukanensis** Bakh.

(of Penibukan, Sabah)

Bull. Jard. Bot. Buitenz. 3, 15 (1937) 124; Beaman *et al. l.c.* 229. **Type:** *Clemens 50214*, Borneo, Sabah, Penibukan (BO).

Tree to 25 m tall. **Twigs** *covered with dense spreading hairs* or *with velvety appressed hairs*. **Leaves** chartaceous, *under surface densely hairy all over* or *glabrous except on veins*, *not subglaucous below*; *elliptic*, *obovate* or *oblong-obovate*, *11–38 × 4–15 cm*, *base subcordate*, *rarely rounded*, *margin not undulate*, *apex acute* to *acuminate*; *midrib sunken above*, covered with dense spreading or velvety appressed hairs below; *lateral veins prominent below*, *5–24 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominent* to *prominulous below*, *densely* or *laxly scalariform*; *petiole 0.5–1.5 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing to 10 crowded flowers. **Male flowers** with *calyx divided into 4 imbricate triangular lobes*. **Female inflorescences** *c.* 0.5 cm long, each bearing to 10 flowers. **Female flowers** with *calyx divided into 4 imbricate ovate* to *semi-circular lobes*. **Fruits** in clusters of 1–3, *on c. 0.5 cm long stalks*, globose, *2–2.5 cm diameter*, *not ribbed*, densely velvety, woody, smooth, symmetric. **Fruit calyx** *not accrescent*; *lobes coriaceous*, *rounded* or *broadly ovate*, *0.2–0.6 × 0.3–0.8 cm*.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In lowland and hill mixed dipterocarp forests, including heath forest.

Key to varieties

Twigs densely covered with spreading hairs. Leaf under surface densely pubescent all over with spreading hairs; intercostal venation densely scalariform............................

var. **penibukanensis**

Tree up to 20 m tall. Leaves obovate, 12–20 × 5–7.5 cm, base subcordate, apex acute to acuminate; lateral veins 9–13 pairs; petiole *c.* 0.5 cm long. Fruits up to 2 cm diameter. Fruit calyx lobes *c.* 0.2 × 0.3 cm.

Endemic to Borneo and confined to Sabah (e.g., *Clemens 50214*, *SAN 31935*, *SAN 64837*, and *SAN 69324*).

Twigs velvety with appressed hairs. Leaves glabrous except for the velvety veins; intercostal venation laxly scalariform...

var. **scalarinervis** Ng

(Latin, *scalaris* = ladder-like, *nervus* = vein; referring to the ladder-like intercostal venation)

Gard. Bull. Sing. 53 (2001) 308. Type: *S 56607*, Borneo, Sarawak (holotype KEP; isotype SAR).

Tree up to 10 m, rarely to 25 m tall. Leaves elliptic, broadly obovate to oblong-obovate, 11–38 × 4–15 cm, base subcordate, rarely rounded, apex acute to acuminate; lateral veins 5–24 pairs; petiole 0.8–1.5 cm long. Fruits to 2.5 cm diameter. Fruit calyx lobes 0.4–0.6 × 0.5–0.8 cm.

Endemic to Borneo and confined to Sarawak (e.g., *S 13586*, *S 13681*, *S 13702*, *S 18639*, *S 34482*, *S 34935*, *S 34962*, *S 35271*, *S 41850*, *S 49997*, and *S 56607*).

53. **Diospyros perfida** Bakh.

(Latin, *perfidus* = unsafe/unreliable; alluding the allegedly poisonous fruits)

Gard. Bull. S. S. 7 (1933) 181, *l.c.* (1938) 340; Argent *et al.* (eds.) *l.c.* 185. **Syntypes:** *bb. 2327*, *bb. 13221* and *Endert 2705*, Borneo, Kalimantan (all at BO).

Tree to 25 m tall. **Leaves** membranaceous, glabrous, *tending to dry black on both sides*; *oblong-elliptic*, *(7.5–)12–25 × (2–)4.5–10 cm*, *base cuneate* to *slightly attenuate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*, prominent below, drying black; *lateral veins prominent below*, *8–11 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *laxly scalariform*; *petiole c. 1 cm long*. **Male inflorescences** *0.5–0.8 cm long*, each bearing 3 crowded flowers. **Male flowers** with *calyx divided into 4 imbricate rounded lobes*; corolla salverform, *c.* 0.7 cm long. **Female inflorescences** *c. 0.3 cm long*, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 imbricate ovate lobes*. **Fruits** usually solitary, on *c.* 0.5 cm long stalks, depressed globose, *to c. 5 cm diameter*, *not ridged*, symmetric, woody, finely velvety when young, becoming smooth and glabrous with age. **Fruit calyx** *accrescent*, *rugose*, *woody*, *initially cup-shaped with 4–5 valvate rounded lobes tightly clasping the lower three-quarters of the fruit*, *then half as the fruit enlarges and finally forming a shallow tray when the fruit is fully grown*; *during the process of enlargement*, *the calyx lobes are stretched so that they look valvate in fruit*; *veins very faint* or *invisible*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 29982*, *SAN 39906*, *SAN 58222*, *SAN 95530*, and *SAN 133947*) and Kalimantan (e.g., *Kostermans 5446*, *Kostermans 5927*, *Kostermans 6774*, *Kostermans 6915*, and *Kostermans 6993*).

Ecology. Common in lowland mixed dipterocarp forest.

Notes. The oblong leaves with scalariform intercostal venation resemble those of *D. hallieri* but differ in the tendency of the midrib to blacken on drying. In Bakhuizen's revision, the local name of *D. perfida* in SE Borneo is recorded as *toeba api* (fiery tuba) which suggests that it is a potent fish poison.

54. **Diospyros pilosanthera** Blanco

(Latin, *pilosantherus* = with pilose or hairy anthers)

Fl. Filip. ed. 1 (1837) 304; Merrill, Spec. Blanc. (1918) 302; Turner *l.c.* 199; Ng *l.c.* (2001) 310; Beaman *et al. l.c.* 229. **Neotype:** *Merrill Spec. Blanc. 820*, the Philippines, Luzon, Batangas Prov. (*n.v.*). **Synonyms:** *D. polyalthioides* Korth. *ex* Hiern *l.c.* 198, Merrill *l.c.* (1921) 485, Bakhuizen *l.c.* (1938) 241, Masamune *l.c.* 605; *D. polyalthioides* var. *polyalthioides* (Korth. *ex* Hiern) Ng *l.c.* (1977) 237; *D. plicata* Merr. *l.c.* (1914) 336, *l.c.* (1929) 240, Masamune *l.c.* 605; *D. cubica* Bakh. *l.c.* (1933) 168, *l.c.* (1938) 253, *l.c.* (1955) plate 56; *D. helferi auct. non* C.B.Clarke: Masamune *l.c.* 603.

Tree to 35 m tall. **Twigs** slender to stout, reddish brown pubescent when young, glabrous when older, drying whitish, greyish or blackish. **Leaves** chartaceous to coriaceous, *not bullate between veins*, glabrous to velvety below, *tending to dry black on upper* or *both sides*; *elliptic*, *oblong*, *oblong-elliptic* or *oblong-obovate*, *5–30 × 2.5–12 cm*, *base cuneate*, *rounded*, *subcordate* to slightly attenuate, *margin not undulate*, *apex acuminate*; *midrib sunken above*, *glabrous below*; *lateral veins faint* to *prominent below*, *5–20 pairs*, *inarching faintly to form multiple anastomosing loops near leaf margin*; *intercostal venation faint* to *prominent below*, *reticulate* to *vaguely scalariform*; *petiole 0.5–1.5 cm long*. **Male inflorescences** *c.* 1 cm long, each bearing 5–12 clustered flowers. **Male flowers** with *calyx divided one quarter to halfway into 4–5 triangular valvate lobes*; corolla slender, salverform, to *c.* 0.7 × 0.2 cm. **Female inflorescences** 0.1–0.5 cm long, each bearing 1–5 flowers. **Female flowers** with *calyx divided into 4–5 valvate lobes* which range from small and simple to large and plicate. **Fruits** in clusters of 1–3, subsessile on 0.1–0.5 cm long stalks, *globose* to *ovoid*, *1.8–3.5 cm diameter*, *symmetric*, *not ribbed*, woody, *smooth* to *faintly vertically lobed*, densely velvety when young, *maturing velvety* or *glabrous*. **Fruit calyx** *not*, *slightly*, or *greatly accrescent*; *lobes spreading* or *reflexed*, *small and not exceeding the fruit in diameter* to *greatly enlarged and thrown into many folds covering the whole fruit*; *veins very faint* to *invisible*.

Distribution. Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku.

Ecology. In lowland, hill to lower montane forests, to 1600 m altitude.

Notes. This species is very variable in the development of its fruit calyx. At one extreme, the fruit calyx may be only slightly accrescent and of smaller diameter than the fruit, but at the other extreme it may be much enlarged and at the same time, thrown into many waves or folds which almost completely cover the fruit. The calyx may also be only slightly wavy or not wavy at all, and erect, clasping the base of the fruit, or reflexed backwards away from the fruit. All these forms are linked by intermediates. The leaves are also very variable in size and degree of hairiness, and the intercostal venation varies from faint to prominent below. In general, the leaves vary independently of the fruits, as a result of which any subdivision based on fruits alone would leave sterile and male specimens un-namable. Subdivision based on leaves alone is also untenable. Out of this complex, only one entity stands out somewhat. This is var. *elmeri* in which large many-folded calyx lobes is combined with leaves often (but not always) velvety below, with intercostal venation prominent below. The remainder make up, by default, the highly variable var. *pilosanthera*. A better subdivision cannot be attempted without examining the species throughout its range, which covers the whole of SE Asia. The reduction of *D. cubica* is based on examination of a photograph from Kew of the type (*Beccari PB 830*, Sarawak).

Key to varieties

Fruit calyx greatly accrescent, lobes thrown into many folds. Leaves more or less velvety below; lateral and intercostal veins prominent below, intercostal venation laxly reticulate to vaguely scalariform..

var. **elmeri** (Merr.) Ng Fig. 1G.

(A.D.E. Elmer, 1870–1942, American botanist and plant collector in Borneo and the Philippines)

Malay. For. 40 (1977) 238, *l.c.* (2001) 310. Basionym: *D. elmeri* Merr. *l.c.* (1929) 243, Bakhuizen *l.c.* (1938) 249, Masamune *l.c.* 602. Type: *Elmer 20070*, Borneo, Sabah (BO, K, L, SING). Synonym: *D. nidus-avis* Kosterm. *l.c.* 464.

Tree to 15 m tall. Leaves chartaceous, *often velvety below*, tending to dry black above; elliptic to oblong-elliptic, 7.5–18(–30) × 2.7–7.2(–11) cm, base cuneate, rounded, subcordate or slightly attenuate, apex acute to acuminate; *lateral veins prominent below*, 7–11(–20) pairs; *intercostal veins prominent below*, *laxly reticulate* to *vaguely scalariform*. Female flowers with plicate calyx lobes. Fruits subsessile, globose, to *c.* 1.8 cm diameter, densely velvety. *Fruit calyx greatly accrescent*, *coriaceous and very plicate* (wavy), covering much of the fruit.

Endemic to Borneo and known from Sabah (e.g., *Boden-Kloss 18688*, *FMS 38648*, *SAN 21362*, *SAN 75954*, and *SAN 77815*), Sarawak (e.g., *S 22842*, *S 32181* and *S 47153*), Brunei (e.g., *Dransfield 7025* and *Hotta 12735*), and Kalimantan (e.g., *Church & Mahyar 1596*, *Kostermans 5588* and *Kostermans 5911*). In lowland mixed dipterocarp forests.

Fruit calyx highly variable, of smaller diameter than the fruit or slightly to greatly enlarged, with the lobes spreading, reflexed or thrown into many folds. Leaves usually glabrous; lateral and intercostal veins usually faint below, with the reticulations stretched parallel to the lateral veins...

var. **pilosanthera**

Tree to 35 m tall. Leaves chartaceous to coriaceous, *glabrous* to velvety below, tending to dry black on upper side or both sides; elliptic to oblong, oblong-elliptic, or oblong-obovate, 5–30 × 2.5–12 cm, base cuneate, rounded or slightly attenuate, apex acuminate; *lateral* *veins faint* to prominent *below*, 5–17 pairs; intercostal venation faint to prominent below, reticulate, *with reticulations stretched parallel to lateral veins*; shorter veins between lateral veins well-developed. Fruits on 0.1–0.5 cm long stalks, globose to ovoid, to 2(–3.5) cm diameter.

Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi and Maluku. In Borneo, known from Sabah (common, e.g., *FMS 41340*, *SAN A 3449*, *SAN 24303*, *SAN 34709*, *SAN 100413*, and *SAN 122557*), Sarawak (common, e.g., *Clemens 22189*, *Fuchs 21274*, *S 13958*, *S 32880*, *S 40726*, and *S 58275*), Brunei (e.g., *BRUN 17429*, *BRUN 17823*, *BRUN 18714*, *BRUN 18927*, and *BRUN 19054*) and Kalimantan (e.g., *Argent et al. 93157*, *van Balgooy 5599*, *bb. 28320*, *Kostermans 5340*, and *Kostermans 13289*). In lowland mixed dipterocarp, peat swamp, coastal, hill to lower montane forests, to 1600 m altitude.

55. **Diospyros piscicarpa** Ridl. Fig. 1H.

(Latin, *piscis* = fish, *carpus* = fruit; alluding the use of the fruit to poison fish)

J. Bot. 63 (1925) 51; Bakhuizen *l.c.* (1938) 259; Anderson *l.c.* 170; Beaman *et al. l.c.* 229. **Type:** *Beccari PB 1957*, Borneo, Sarawak (K, photo).

Tree to 27 m tall. **Twigs** somewhat stout, smooth, young ones tomentose, older ones glabrous, drying whitish with blackish dots. **Leaves** *chartaceous*, not bullate between veins, glabrous, drying somewhat shiny on upper surface, *not subglaucous below*; *elliptic*, *10–20 × 3.5–8.5 cm*, *base cuneate* to *rounded* or slightly attenuate, *margin not undulate*, *apex acuminate*; *midrib sunken above*, groove extended into the channelled petiole; *lateral veins prominulous above*, *prominent below*, *6–12 pairs*, *inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal veins prominulous below*, *reticulate*; *petiole 0.8–1.8 cm long*, tending to dry blacker than stem, *not wrinkled*. **Male inflorescence** a 1–3 flowered cyme, 0.5–1 cm long, cymes often arising from raceme-like short reproductive shoots 3–5 cm long. **Male flowers** with *tubular*, *almost truncate* (*shallowly 4-lobed*) *calyx*; corolla *c.* 1.2 cm long. **Female inflorescences and flowers** unknown. **Fruits** 1–3, on stalks of 0.5–2 cm long, ellipsoid to globose, *to c. 5 cm diameter*, *not ribbed*, smooth, shiny and woody, glabrous, symmetric. **Fruit calyx** *accrescent*, *divided into 4 valvate plicate lobes*; *lobes prominently veined*, *leafy coriaceous*, *c. 2 × 2 cm*, *clasping fruit base*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *Berhaman et al. AB 89*, *SAN 83139*, *SAN 107397*, *SAN 132031*, and *SFN 26280*), Sarawak (e.g., *Chin 2694*, *Hewitt 868*, *S 30421*, *S 36530*, and *S 39568*) and Kalimantan (e.g., *Burley et al. 2855*, *Burley et al. 2863* and *Burley et al. 2869*).

Ecology. In lowland mixed dipterocarp forest, to 700 m altitude.

Use. The fruits are used to stun fish, hence the local names *tuba*, *buah tuba*, *tuba api*, or *tuba kalingan*.

Notes. Easily confused with *D. frutescens* but the fruits much larger and the leaves non-bullate, with lateral veins prominulous (not sunken) above. The petiole tends to dry black in contrast to the lighter coloured stem to which it is attached.

56. **Diospyros plectosepala** Hiern Fig. 6I.

(Greek, *plectos* = twisted, *sepalum* = sepal; alluding the twisted sepals)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 201; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1937) 106; Masamune *l.c.* 605; Ng *l.c.* (2001) 310. **Type:** *Beccari PB 3225*, Borneo, Sarawak (K). **Synonyms:** *D. poiensis* Bakh. *l.c.* (1933) 181, *l.c.* (1937) 111, Masamune *l.c.* 605, Anderson *l.c.* 170; *D. setosa* Bakh. *l.c.* (1933) 184, *l.c.* (1937) 118, *l.c.* (1955) Plate 12, Masamune *l.c.* 606.

Tree to 8 m tall. **Leaves** membranaceous to chartaceous, glabrous, *not subglaucous below*; *elliptic* or *ovate*, *5–13 × 2–5.5 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous below*, *4–7 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation very faint*, *laxly reticulate*; *petiole 0.4–0.9 cm long*. **Male inflorescences** *0.1–0.2 cm long*, each bearing 1 or a few flowers. **Male flowers** with *calyx divided to base into 4–5 imbricate rounded lobes*; corolla salverform. **Female inflorescences** *0.1–0.2 cm long*, each bearing solitary flower. **Female flowers** with *calyx divided into 4–5 rounded imbricate lobes*. **Fruits** solitary, on 0.1–0.2 cm stalks, *oblong-ellipsoid*, *2.5–3 × 1–2 cm*, *not ribbed*, symmetric, sparsely appressed hairy, thin-walled, drying brittle and easily crushed. **Fruit calyx** *non-accrescent*, *lobes about 0.3 × 0.3 cm*.

Distribution. Endemic to Borneo and known in Sarawak by four collections apart from its type (*Clemens 20304*, type of *D. poiensis*; *Haviland 2324*, type of *D. setosa*; *S 42287* and *S 44025*).

Ecology. A rare species in lowland to lower montane forests, to 1500 m altitude.

Notes. The ellipsoid subsessile fruits distinguish this from other species. A Sabah specimen (*SAN 125886*) differs in having densely appressed-hairy ovoid fruits with a prolonged beak but otherwise matches this species.

57. **Diospyros puncticulosa** Bakh. Fig. 6J.

(Latin, *puncticulosus* = minutely dotted; alluding the fruits)

Gard. Bull. S. S. 7 (1933) 164, *l.c.* (1937) 91; Anderson *l.c.* 170; Argent *et al.* (eds.) *l.c.* 186. **Type:** *Beccari PB 1948*, Borneo, Sarawak (K, photo). **Synonym:** *Maba beccarii* Hiern *l.c.* 140, Merrill *l.c.* (1921) 483, Masamune *l.c.* 606.

Tree to 30 m tall. **Twigs** *drying consistently black.* **Leaves** chartaceous to coriaceous, glabrous, *drying black on both sides*; *elliptic* to *ovate*, *3.5–10 × 1.2–4 cm*, base broadly cuneate to rounded, apex acuminate; midrib sunken or flat above; lateral veins invisible; *intercostal venation invisible*; petiole *c.* 0.3 cm long. **Male** and **female inflorescences** and **flowers** unknown. **Fruits** solitary, on 0.2–0.3 cm long stalks, ovoid, to *c.* 6 × 3 cm, with acuminate beak, symmetric, woody, with smooth to pimply surface, glabrous. **Fruit calyx** not accrescent, divided into 4 imbricate rounded lobes; lobes *c.* 0.2 × 0.3 cm.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 138851* and *SAN 44504*), Sarawak (e.g., *FMS 7158*, *S 36248*, *S 45453*, *S 48377*, *S 51497*, and *S 59883*), Brunei (e.g., *S 10662*), and Kalimantan (e.g., *Kostermans 10216*).

Ecology. In lowland mixed dipterocarp forest, to 400 m altitude.

Notes. Close to *D. evena* in the small leaves, invisible intercostal venation, the way in which the leaves and twigs drying black, and the imbricate non-accrescent fruit calyx, but the leaves of *D. evena* are generally obovate, with rounded, retuse or acute (rarely acuminate) apex. Close also to *D. maingayi* but differs by its smaller leaves.

Upon reduction of *Maba* to *Diospyros*, this species was given a new name by Bakhuizen because the name *D. beccarii* had already been used for another species.

58. **Diospyros pyrrhocarpa** Miq.

(Greek, *pyrrhos* = fiery red or yellow, *karpos* = fruits)

Fl. Ind. Bat., Suppl. (1860) 250; Bakhuizen *l.c.* (1938) 305; Ng *l.c.* (1978) 83; Anderson *l.c.* 170; Turner *l.c.* 199. **Type:** *Diepenhorst HB 2351*, Sumatra, Priaman (holotype U, *n.v.*). **Synonym:** *D. asterocalyx* Hiern *l.c.* 193, Merrill *l.c.* (1921) 484, Masamune *l.c.* 601.

Tree to 23 m tall. **Twigs** pubescent when young, glabrous when older, drying greyish to brownish. **Leaves** chartaceous, glabrous, *not bullate between veins*, *drying with a yellowish tinge below*; *oblong-elliptic* to *oblong-obovate*, *15–30 × 5–9 cm*, *base cuneate* to slightly attenuate, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *8–12 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous above*, *prominent below*, *laxly reticulate*; *petiole 1–2.3 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing 1–3 flowers. **Male flowers** with *calyx divided into 4 triangular valvate lobes*; corolla salverform. **Female inflorescences** 0.5–1 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate*, velvety, spreading to slightly plicate *lobes* of *c.* 1 × 0.5 cm. **Fruits** 1–3, on 0.5–1 cm long stalks, globose to ovoid-ellipsoid, *to c. 5 cm diameter*, *not ribbed*, symmetric, *densely velvety*, *deeply wrinkled and conspicuously puckered when dried.* **Fruit calyx** *accrescent*, *divided almost to base*; *lobes at first spreading*, *then reflexed completely so that the 4 triangular enlarged woody lobes point downwards* (i.e. away from the apex); *veins faint* or *invisible*.

Distribution. India (Assam), Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (common, e.g., *FMS 41174*, *Pennington 7886*, *SAN 16531*, *SAN 39470*, and *SAN 97052*), Sarawak (e.g., *Clemens 15198*, *Clemens 20122* and *S 32663*) and Kalimantan (e.g., *Kostermans 5912* and *Kostermans 13766*).

Ecology. In lowland mixed dipterocarp forest.

59. **Diospyros ridleyi** Bakh. Fig. 2G.

(H.N. Ridley, 1855–1956, sometime Director of the Botanic Gardens Singapore)

Gard. Bull. S. S. 7 (1933) 183, *l.c.* (1938) 354; Ng *l.c.* (1978) 84; Turner *l.c.* 199; Ng *l.c.* (2001) 310. **Type:** *Ridley s.n.* (= *Herb. Sing. No. 40455*), Peninsular Malaysia, Johore (holotype SING). **Synonym:**

D. dajakensis Bakh. *l.c.* (1933) 168, *l.c.* (1938) 321; *D. bantamensis auct. non* Bakh.: Coode *et al.* (eds.) *l.c.* 87.

Tree to 30 m tall. **Twigs** rather stout, sparsely lenticellate, rugose and prominently cracked, reddish-brown appressed pubescent when young, glabrous when older. **Leaves** coriaceous, *not bullate between veins*, *glabrous*; *upper surface dull*, *lower surface shining*, *not subglaucous*, on drying without yellowish tinge; *broadly elliptic* to *ovate*, *8–24 × 4–11 cm*, *base rounded*, *broadly cuneate* or *almost subcordate*, *margin not undulate*, *apex shortly acuminate*; *midrib more or less sunken above* (sometime only shallowly depressed or not sunken); *lateral veins prominent below*, *6–8 pairs*, *arching and with a tendency to form intramarginal vein-loops near leaf margin*; *intercostal venation prominulous on both sides*, *finely reticulate above*, *laxly reticulate below*; *petiole 0.6–1.5 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing about 3 flowers. **Male flowers** with *calyx narrowly tubular*, 0.7 cm long, *divided halfway into 4–5 triangular valvate lobes*; corolla salverform, *c.* 1 cm long in bud. **Female inflorescences** 0.2–1 cm long, each *bearing solitary flower*. **Female flowers** with *calyx divided into 4–5 valvate leafy coriaceous lobes*, *c.* 0.8 × 0.9 cm, with undulate margins. **Fruits** solitary, on 0.2–1 cm long stalks, globose to ovoid, *to c. 5 cm diameter*, *not ribbed*, symmetric, *with thick woody smooth to pimpled walls*, *glabrous* or *velvety*. **Fruit calyx** *accrescent*, *expanded into a more-or-less flattened 4–5-pointed woody plate*, *with edges of the lobes stretched until no longer evident*, or *persisting as a reflexed narrow fringe*; *veins very faint* or *invisible*.

Distribution. Andamans, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *Chew & Corner 4917*, *SAN 27460*, *SAN 30226*, *SAN 62184*, and *SAN 84128*), Sarawak (e.g., *Ding Hou 347*, *S 15824*, *S 24137*, *S 27187*, and *S 28024*), Brunei (e.g., *BRUN 267*, *BRUN 550*, *BRUN 603*, *BRUN 835*, and *BRUN 16951*), and Kalimantan (e.g., *bb. 10490*, *bb. 15872*, *bb. 15877*, and *Kostermans 10322*).

Ecology. Mainly in lowland mixed dipterocarp forest, but once found at 1600 m altitude (*Chew & Corner 22536*, Sabah).

Notes. The medium-sized elliptic, coriaceous, glabrous leaves, lateral veins tending to form vein-loops near the leaf margins, and the reticulation of intercostal venation (fine on upper surface, lax on lower surface) are quite distinctive, as also the form of the fruit calyx. From *D. areolata*, this species can be quickly distinguished by the dull (not shiny) leaf upper surface.

60. **Diospyros rigida** Hiern Fig. 1I.

(Latin, *rigidus* = stiff or rigid; alluding the stiffly leathery leaves)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 257; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 367; Masamune *l.c.* 605; Ng *l.c.* (1978) 84; Anderson *l.c.* 170; Turner *l.c.* 199; Coode *et al.* (eds.) *l.c.* 89. **Type:** *Beccari PB 2285*, Borneo, Sarawak (K). **Synonym:** *D. subrigida* Hochr., Bull. Inst. Bot. Buitenz. 19 (1904) 24, Merrill *l.c.* (1921) 485, Masamune *l.c.* 606.

Tree to 26 m tall. **Twigs** thick, greyish black, appressed tomentose, becoming glabrous with age, *rugose*. **Leaves** *coriaceous*, glabrous, *drying subglaucous with yellowish tinge below*; *oblong*, *15–45 × 6.5–14 cm*, *base rounded* to *subcordate*, *margin not undulate*, *apex acute* to *slightly acuminate*; *midrib sunken*, *shallowly depressed* or *prominent above*; *lateral veins prominent* *below*, *10–20 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominent below*, *finely reticulate*; *petiole 1.5–3 cm long*. **Male** and **female inflorescences** and **flowers** unknown. **Fruits** 1–3, on 1.5–2 cm long stalks, globose, *to c. 4.5 cm diameter*, *not ribbed*, symmetric, smooth, glabrous, with woody wall. **Fruit calyx** *accrescent*, *divided into 4 leafy coriaceous*, *valvate*, *prominently veined lobes*; lobes *c.* 3 × 2 cm, plicate, erect, clasping the base of fruit.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 66872*), Sarawak (e.g., *Beccari PB 2285*, *Pennington 7963*, *S 17836*, and *S 19724*), Brunei (e.g., *Coode 6785* and *Wong WKM 1291*) and Kalimantan (e.g., *Afriastini 1182*).

Ecology. In lowland mixed dipterocarp forest.

61. **Diospyros rufa** King & Gamble

(Latin, *rufus* = reddish; referring to the indumentum of young twigs)

J. As. Soc. Beng. 74, 2 (1906) 228; Bakhuizen *l.c.* (1938) 292; Ng *l.c.* (1978) 84; Turner *l.c.* 199; Ng *l.c.* (2001) 310. **Syntypes:** *King's Collector 3330*, *King's Collector 5409* and *King's Collector 6712*, Peninsular Malaysia, Perak (all at SING). **Synonym:** *D. swingleri* Kosterm. *l.c.* 172, Coode *et al.* (eds.) *l.c.* 90.

Tree to 30 m tall. **Twigs** somewhat stout, rugose or striate, drying brownish, reddish tomentose when young, glabrous when older. **Leaves** coriaceous, *not bullate between veins*, not tending to dry black, *not subglaucous below*, glabrous; *elliptic*, *12–21 × 5.5–11 cm*, *base broadly cuneate*, *margin not undulate*, *apex acuminate*; *midrib variably sunken* to *shallowly depressed above*; *lateral veins prominent below*, *7–10 pairs*, *inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation prominulous below*, *laxly reticulate*; *petiole 1–1.7 cm long*. **Male inflorescences** to 1 cm long, each bearing 3–10 flowers. **Male flowers** with *calyx divided halfway* or *three-quarter way into 4 triangular valvate lobes*; corolla salverform, 0.6–1 cm long. **Female inflorescences** to 1 cm long, each bearing many clustered flowers. **Female flowers** with *calyx* velvety, *divided halfway into 4 triangular valvate lobes*. **Fruits** in clusters of 1–3 or more, on *c.* 1 cm long stalks, borne on thick (0.7–2 cm thick) branches, ellipsoid-globose, *c. 3.5 cm diameter*, *not ribbed*, symmetric, glabrous, shallowly puckered when dry. **Fruit calyx** *only slightly accrescent*; *lobes c. 0.5 × 0.5 cm*, *flattened against the base of fruit*; *veins very faint* or *invisible.*

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 67168*), Sarawak (e.g., *S 26941*, *S 27760*, *S 35981*, *S 49901*, and *S 56608*), Brunei (e.g., *BRUN 24*, *BRUN 266*, and *FMS 30432*) and Kalimantan (e.g., *Veldkamp 8539*).

Ecology. In lowland mixed dipterocarp forest.

62. **Diospyros siamang** Bakh. Fig. 2H.

(after its Sumatran name—*siamang*)

Gard. Bull. S. S. 7 (1933) 184, *l.c.* (1938) 261; Ng *l.c.* (1978) 86; Anderson *l.c.* 170; Turner *l.c.* 199; Argent *et al.* (eds.) *l.c.* 186. **Type:** *Boschpr. F. 198*, Sumatra, Palembang, Banjuasin, Bajung Lintjir (L).

Small tree. **Leaves** chartaceous, glabrous, shiny above, *subglaucous below*, somewhat concave, as a result of which the base and apex of flattened specimens are usually forced to fold, one side over the other; *elliptic* to *elliptic-oblong*, 10.5–21 × 4.5–9.5 cm, base rounded, apex acute to slightly acuminate; midrib sunken above; *lateral veins* prominent below, 6–9 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *laxly reticulate*; petiole *c.* 1 cm long. **Male inflorescences** *c.* 1 cm long, each bearing several flowers. **Male flowers** with calyx divided into 4–5 valvate lobes; corolla salverform. **Female inflorescences** and **flowers** unknown. **Fruits** 1–5, on 1–1.5 cm long stalks, urn-shaped (with an expanded rim around a sunken apex), to *c.* 3.8 × 3 cm, symmetric, woody, velvety. **Fruit calyx** divided into 4 valvate lobes, accrescent, woody, erect, clasping the base of fruit; margins of lobes auriculate-plicate.

Vernacular name. Sarawak—*kayu malam balih* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sarawak (e.g., *S 468*, *S 487*, *S 2656*, and *S 8048*) and Kalimantan (*bb. 32400* and *Buwalda 7841*).

Ecology. Common in peat swamp forest.

63. **Diospyros simaloerensis** Bakh. Fig. 6K.

(of Simaloer island, Sumatra)

Gard. Bull. S. S. 7 (1933) 185, *l.c.* (1937) 128; Ng *l.c.* (2001) 311. **Syntypes:** *Achmad 580*, *Achmad 1343* and *Achmad 1391*, Sumatra, Simaloer (all at BO). **Synonym:** *D. paraoesi* Bakh. *l.c.* (1933) 180, *l.c.* (1937) 108.

Tree to 30 m tall. **Twigs** slender, densely short-tomentose when young, glabrescent, drying greyish, rugulous, prominently cracked. **Leaves** chartaceous, *not subglaucous* and usually glabrous but sometimes (e.g., *S 23628*) densely hairy *below*; *elliptic*, *ovate* or *obovate*, *4–10 × 1.5–5 cm*, *base cuneate* to rounded, *margin not undulate*, *apex acuminate*; *midrib sunken above to form a groove filled with hairs*; *lateral veins prominent below*, *4–5 pairs*, *inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation faint*, *vaguely reticulate*; *petiole 0.3–0.8 cm long*. **Male** and **female inflorescences** slender, to *3 cm long*, each bearing 1–5 flowers. **Flowers** with *calyx divided into 4 rounded imbricate lobes*. **Fruits** in clusters of 1–5, each on 0.5–2 cm long stalk, *globose*, *to c. 1.5 cm diameter*, *not ribbed*, symmetric, *densely velvety*, thin-walled and deeply wrinkled/puckered on drying. **Fruit calyx** *not accrescent*; *lobes c. 0.3 × 0.2 cm*.

Distribution. Sumatra and Borneo. In Borneo, known from Sabah (e.g., *SAN 16766*, *SAN 70321* and *SAN 99860*), Sarawak (e.g., *S 15376*, *S 23775*, *S 23811*, and *S 43353*) and Kalimantan (e.g., *bb. 10162*, type of *D. paraoesi*).

Ecology. In lowland mixed dipterocarp forest, to 600 m altitude.

Notes. The Sumatran population differs from the Bornean population in the fruits and inflorescences more or less glabrous instead of velvety. The Bornean *D. simaloerensis* is distinguished from *D. singaporensis* by its velvety-hairy puckered (instead of glabrous shiny black smooth) fruits. It is distinguished from *D. subrhomboidea* and *D. oligantha* by its 0.5–2 cm fruit stalk, with individual pedicels at least 0.5 cm long (instead of shorter stalks and shorter pedicels).

64. **Diospyros singaporensis** Bakh.

(of Singapore)

Gard. Bull. S. S. 7 (1933) 185, *l.c.* (1937) 110; Ng *l.c.* (1978) 86; Turner *l.c.* 199. **Type:** *Md. Nur 14*, "Cult. Bot. Gard." Singapore (holotype SING).

Tree to 28 m tall. **Twigs** *not tending to dry black*. **Leaves** chartaceous, glabrous, *drying reddish brown* or *blackish above*, *reddish brown below*; *elliptic*, *2.8–11 × 1.4–4 cm*, base rounded to cuneate, *apex acuminate*; midrib prominulous to sunken above; *lateral veins faintly visible below*, *3–5 pairs*, arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole 0.2–0.5 cm long. **Male inflorescences** 0.1–0.3 cm long, each bearing *c.* 3 flowers. **Male flowers** with calyx divided into 4 imbricate lobes; corolla salverform. **Female inflorescences** *0.5–1.3 cm long*, each bearing solitary flower. **Female flowers** with calyx divided into 4 rounded imbricate lobes. **Fruits** solitary, *on 0.5–1.3 cm long stalks*, *globose*, *2.5–3.5 cm diameter*, symmetric, glabrous, smooth, shiny black, *thick-walled* (not easily crushed when dried). **Fruit calyx** not accrescent; lobes measuring *c.* 0.3 × 0.3 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 27205*, *SAN 29378*, *SAN 62398*, and *SAN 110420*) and Sarawak (e.g., *S 35145*).

Ecology. In lowland mixed dipterocarp forest.

Notes. This species is distinguished by the combination of small leaves and glabrous, smooth, shiny black globose fruits. The fruits do not wrinkle or pucker on drying.

65. **Diospyros squamaefolia** Kosterm. Fig. 6L.

(Latin, *squamus* = scale, *folium* = leaf; alluding the shape of the leaves, which resemble fish scales)

Blumea 23 (1977) 470. **Type:** *Wood SAN 15475*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype L; isotypes A, K, KEP, SING).

Treelet to 5 m tall. **Twigs** *on drying not consistently black*. **Leaves** chartaceous, glabrous, *on drying not consistently black*, *not glaucous below*; *rhombic* (*with the upper and lower halves narrowed abruptly into an attenuate base and acuminate apex*), *1.3–2.5 × 0.6–1.6 cm*; midrib very slender, sunken above and filled with minute hairs; lateral veins practically invisible; *intercostal venation invisible*; petiole 0.1–0.2 cm long. **Male** and **female inflorescences** *0.1–0.2 cm long*, *each bearing subsessile solitary flower*. **Male** and **female flowers** with calyx divided into 4 imbricate rounded lobes; *corolla salverform*, to *c. 0.8 cm long*. **Fruits** solitary, *subsessile*, on 0.1–0.2 cm long stalks, *globose*, to *c.* 1.5 cm diameter, symmetric, glabrous, smooth and thin-walled. **Fruit calyx** non-accrescent; lobes *c.* 0.1 × 0.2 cm.

Distribution. Endemic to Borneo and known only from Sabah (e.g., *Ridsdale 1934*, *SAN 19156*, *SAN 41428*, *SAN 93630*, and *SAN 108746*).

Ecology. Common in lowland mixed dipterocarp forest.

Notes. The rhombic leaves of *D. squamaefolia* are indistinguishable from the rhombic form of *D. graciliflora*, but the flowers and fruits differ in being subsessile. Also, *D. squamaefolia* is restricted to Sabah and *D. graciliflora* to Sarawak.

66. **Diospyros styraciformis** King & Gamble Fig. 2I.

(Latin, *-formis* = with a shape/form of; alluding the fruits which resemble those of *Styrax*, Styracaceae)

J. As. Soc. Beng. 74, 2 (1906) 216; Bakhuizen *l.c.* (1938) 287; Ng *l.c.* (1978) 87; Turner *l.c.* 199; Ng *l.c.* (2001) 311. **Syntypes:** *Maingay 969*, Peninsular Malaysia, Malacca (K) and *Ridley 3787*, Singapore (SING). **Synonyms:** *D. sarawakana* Bakh. *l.c.* (1933) 184, *l.c.* (1938) 288, Masamune *l.c.* 605, Anderson *l.c.* 170, Coode *et al.* (eds.) *l.c.* 89; *D. styraciformis* var. *sarawakana* (Bakh.) Ng *l.c.* (1977) 241; *D. clavipes* Bakh. *l.c.* (1933) 166, *l.c.* (1938) 289, Anderson *l.c.* 168.

Tree to 20 m tall. **Leaves** chartaceous to coriaceous, glabrous, *not bullate between veins*, *not subglaucous below*; *elliptic*, *oblong-elliptic* or *ovate*, *7.5–15(–18) × 2.5–7(–10) cm*, *base cuneate*, rarely rounded or subcordate, often bearing a pair of pit-glands, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins sunken above*, *prominent below*, *5–9 pairs* with basal pairs mostly diverging at an angle of 30–45° from midrib, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *vaguely scalariform*; *petiole 0.5–1.5 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing several flowers. **Male flowers** with *calyx divided into 4 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** 1–2 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate triangular lobes*. **Fruits** *in clusters of 1–3 on branchlets of 0.5–2 cm thick*, *on stalks 1–2 cm long*, depressed globose, *to c. 3.5 cm diameter*, often slightly sunken at apex, symmetric, velvety, woody, *not ribbed*. **Fruit calyx** *accrescent*, *forming a cup fitting basal third or quarter of the fruit*; *lobes 4*, *erect* or *more commonly dilated and forming a narrow reflexed* or *erect fringe around mouth of the cup*; *veins very faint or invisible*.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 109461*), Sarawak (common, e.g., *Haviland 2316*, *S 19335*, *S 38328*, and *S 64627*), Brunei (e.g., *BRUN 5042* and *Niga 88*), and Kalimantan (e.g., *Teijsmann 11397*, type of *D. clavipes*).

Ecology. In lowland mixed dipterocarp forest and limestone hill forest, to 950 m altitude.

Use. The fruits are used to stupefy fish.

Notes. In Borneo, the fruit calyx usually has the margin dilated and reflexed whereas in Peninsular Malaysia, the margin is usually non-dilated and erect. *D. styraciformis* differs from *D. lanceifolia* mainly in the fruit stalk which is 1–2 cm long (instead of 0.1–0.6 cm) and the persistently velvety fruits.

67. **Diospyros subrhomboidea** King & Gamble Fig. 6M.

(Latin, *sub-* = somewhat, *rhomboideus* = almost rhombic; alluding the leaf shape)

J. As. Soc. Bengal 74, 2 (1906) 209; Bakhuizen *l.c.* (1937) 101; Ng *l.c.* (1978) 97; Turner *l.c.* 200; Ng *l.c.* (2001) 311. **Type:** *King's Collector 7302*, Peninsular Malaysia, Perak, Larut (SING). **Synonyms:** *D. confusa* Bakh. *l.c.* (1933) 167, *l.c.* (1937) 106, Ng *l.c.* (1978) 67; *D. jaherii* Bakh. *l.c.* (1933) 173, *l.c.* (1937) 105, Masamune *l.c.* 604; *D. kajangensis* Bakh. *l.c.* (1937) 109.

Tree to 20 m tall. **Twigs** hairy when young, becoming glabrous with age. **Leaves** chartaceous to membranaceous, glabrous or hairy on midrib below, with scattered pit-glands on lower surface, tending to dry paler below, darker above, *not subglaucous below*; *ovate*, *elliptic* or *obovate*, *3.5–14 × 1.5–5.4 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*, appressed hairy below; *lateral veins prominent*, *3–8 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous*, *reticulate*; *petiole 0.2–0.5 cm long*. **Male inflorescences** *0.1–0.2 cm long*, each bearing solitary terminal flower. **Male flowers** with *calyx divided into 4 imbricate rounded lobes*; corolla salverform, to *c.* 1.2 cm long. **Female inflorescences** *0.1–0.3 cm long*, each bearing usually solitary flower, sometimes arising on leafless short shoots to 4 cm long, which resemble racemes. **Female flowers** with *calyx divided into 4 imbricate lobes*. **Fruits** solitary, on 0.1–0.3 cm long stalks, *globose*, to *c.* 1.5 cm diameter, *not ribbed*, symmetric, *densely appressed hairy* (thinly hairy to glabrous on mature fruits), thin-walled and wrinkled-puckered when dried. **Fruit calyx** *not accrescent*; *lobes c. 0.2 × 0.2 cm.*

Distribution. Sumatra, Singapore, Java, and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 16773*, *SAN 37052*, *SAN 77693*, *SAN 94314*, and *SAN 100190*), Sarawak (common, e.g., *S 21746*, *S 23008*, *S 41137*, *S 43881*, and *S 43909*), Brunei (e.g., *Dransfield 6895*), and Kalimantan (e.g., *Jaheri 128* and *Mogea 4185*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Notes. The smallish elliptic leaves with scattered pit-glands on the under surface and the small round puckered fruits are characteristic of this quite common species, which used to be difficult to understand because Bakhuizen had split it into four species based on very vague differences. The fruits resemble those of *D. oligantha*.

68. **Diospyros subtruncata** Scheff. *ex* Hochr.

(Latin, *sub-* = somewhat, *truncatus* = truncate; alluding the calyx)

Plant. Bogor. Exsicc. (1904) 15; Bakhuizen *l.c.* (1938) 310; Anderson *l.c.* 170. **Syntypes:** *Teijsmann 962* and *Teijsmann 5646*, "Cult. Hort. Bot." Bogor (all at BO).

Tree to 22 m tall. **Leaves** chartaceous, somewhat bullate between veins, glabrous, *not subglaucous below*; *oblong-elliptic* to *oblong-ovate*, *21–26 × 6.5–8.5 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins c. 12 pairs*, *arching and diminishing toward leaf margin*, *sunken above*, *prominent below*; *intercostal venation prominulous above*, *prominent below*, *laxly scalariform*; *petiole 1–1.3 cm long*. **Male inflorescences** *c.* 1 cm long, each bearing about 3 flowers. **Male flowers** with *calyx a deep barrel-shaped cup*, *not divided into lobes*, covering most of corolla; corolla about 1 cm long, in bud protruding slightly above calyx. **Female inflorescences** and **flowers** unknown. **Fruits** solitary or a few per axil, on stout 0.6–1 cm long stalks, obovoid, to *c. 3 × 2.8 cm*, *not ribbed*, symmetric, with thick woody walls, densely velvety. **Fruit calyx** *a truncate cup*, *split and flattened into a broken plate c. 1.8 cm diameter.*

Distribution. Sumatra and Borneo. In Borneo, rare in Sarawak and represented by two collections (*S 22248* and *S 22529*).

Ecology. In lowland mixed dipterocarp forest, to 400 m altitude.

69. **Diospyros sulcata** Kosterm.

(Latin, *sulcatus* = grooved; alluding the midrib)

Blumea 23 (1977) 471. **Type:** *Meijer SAN 39320*, Borneo, Sabah, Sandakan district, Tawai Plateau (holotype L; isotype SAN).

Tree to 27 m tall. **Leaves** chartaceous to coriaceous, glabrous, *not bullate between veins*, *not subglaucous below*; *oblong-elliptic* to *oblong*, *10–23 × 3–7.5 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate* to *acute*; *midrib sunken above*; *lateral veins barely visible*, *8–13 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation faint*, *laxly reticulate*; *petiole 1–1.5 cm long*. **Male inflorescences** and **flowers** unknown. **Female inflorescences** *c.* 0.3 cm long, each bearing 3 or more condensed flowers. **Female flowers** with *calyx divided into 5 valvate erect lobes*; *sides of each lobe bent back against each other.* **Fruits** solitary, subsessile, ovoid or globose, *to c. 4 cm diameter*, *not ribbed*, symmetric, apex slightly depressed, drying black and grooved vertically between seeds. **Fruit calyx** *accrescent*, *divided deeply into 5 coriaceous valvate lobes of c. 1 cm long*; *lobes curved upwards following curvature of fruit base*, *with two sides of each lobe bent backwards to almost touch each other*; *veins very faint or invisible*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 29320* and *SAN 41891*) and Sarawak (e.g., *S 19389* and *S 33928*).

Ecology. In hill, lower montane and upper montane forests, at 850–2100 m altitude.

Notes. The shape of the calyx in fruit is very distinctive and reminescent of *D. brainiana*, which is easily differentiated by the presence of intramaginal vein-loops on the leaves.

70. **Diospyros sumatrana** Miq.

(of Sumatra)

Pl. Jungh. (1851–55) 203; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 184; Masamune *l.c.* 606; Ng *l.c.* (1977) 242, *l.c.* (1978) 87; Anderson *l.c.* 170; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Argent *et al.* (eds.) *l.c.* 187; Ng *l.c.* (2001) 311. **Type:** *Junghuhu s.n.*, Sumatra, Angkola (holotype U, *n.v.*). **Synonyms:** *D. monticola* Kosterm. *l.c.* 463, Beaman *et al. l.c.* 229; *D. beccarii* Hiern *l.c.* 204, Merrill *l.c.* (1921) 484, Bakhuizen *l.c.* (1938) 239, Masamune *l.c.* 601, Coode *et al.* (eds.) *l.c.* 167.

Tree to 30 m tall. **Twigs** hairy when young, becoming glabrous with age. **Leaves** chartaceous, finely hairy below to glabrous, tending to darken above on drying, *not subglaucous below*; *elliptic*, *ovate*, *oblong* or *obovate*, *3.5–16(–17)* × *1.3–7 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken* to *prominent above*; *lateral veins prominent below*, *5–9 pairs*, *arching and diminishing toward leaf margin* or *sometimes linked near leaf margin to form an intramarginal vein-loops*; *intercostal venation prominulous below*, *vaguely scalariform* to *vaguely reticulate*; *petiole 0.2–0.7 cm long*. **Male inflorescences** *c. 0.2 cm long*, each bearing about 3 subsessile flowers. **Male flowers** with *calyx divided into 4 triangular valvate leafy lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** *c. 0.2–0.5 cm long*, each bearing 1–3 subsessile flowers. **Female flowers** with *calyx divided into 4 broadly ovate valvate leafy lobes*. **Fruits** usually solitary, subsessile (stalks 0.2–0.5 cm long), *ellipsoid* or *oblong*, *to c. 2.5* × *1.2 cm*, *mostly symmetric*, *sometimes asymmetrically curved*, glabrous, *smooth* or *shallowly lobed*. **Fruit calyx** slightly *accrescent*; *lobes leafy*, *erect* or *spreading*, *to c. 0.6* × *0.5 cm.*

Vernacular name. Sarawak—*entam* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (common, e.g., *Clemens 32541*, *Pereira JTP 469*, *SAN 16697*, *SAN 95613*, and *SAN 113910*), Sarawak (common, e.g., *Frodin 2118*, *Jacobs 5331*, *S 22388*, *S 23354*, and *S 53577*), Brunei (e.g., *Coode 7335*, *Johns 7381*, *Sands 5338*, and *Wong WKM 1232*), and Kalimantan (e.g., *Burley 710*, *Church & Mahyar 1538*, *Church 448*, *Kostermans 7253*, and *Sidiyasa 703*).

Ecology. In lowland mixed dipterocarp forest, to 800 m altitude.

Notes. The leaf size and other leaf features are very variable. Bakhuizen divided the species into two varieties: var. *decipiens* with small leaves, caudate-acuminate apices and curved lateral veins, and var. *flavicans* with large leaves, short obtuse-acuminate apices and ascending lateral veins. However, there are many intermediates, which completely blur the distinction. The species is best characterised by its small subsessile ellipsoid to oblong (never globose) fruits and leafy 4-lobed fruit calyx. In Borneo, it may be confused with *D. elliptifolia* and *D. tuberculata*. The former differs in that the midrib above appears as a bordered groove, especially towards the base, and the leaf is almost subsessile. The latter has flowering and fruiting peduncles 0.5–1 cm long, fruits larger and asymmetric, with one side more curved than the other; female calyx larger and more plicate. *D. monticola* is merely a glabrous montane form with small, elliptic, somewhat coriaceous leaves. *D. beccarioides* differs in its longer leaves (16–30 cm long), somewhat more prominent intramarginal veins, larger (2.5 cm diameter) globose fruits, and accrescent calyx lobes to 2 × 1.5 cm.

71. **Diospyros toposia** Ham.

(from its Indian name—*toposi*)

Trans. Linn. Soc. 15, 2 (1827) 115; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 298; Masamune *l.c.* 606; Ng *l.c.* (1978) 89; Turner *l.c.* 200. **Type:** *Wallich 4122E*, India, Gongachora (K-W). **Synonym:** *D. foveo-reticulata* Merr. *l.c.* (1909) 308, *l.c.* (1929) 247, Masamune *l.c.* 603.

Tree to 13 m tall. **Twigs** slender, short-tomentose, glabrescent, sparsely lenticellate, drying yellowish or blackish, rugose, prominently cracked. **Leaves** chartaceous to coriaceous, glabrous, *plane* or *bullate* (puckered) *between veins*, *drying with a yellowish tinge*; *oblong* to *oblong-elliptic*, *13–34 × 3.5–11 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex short-acuminate*; *midrib*, *lateral veins* and *intercostal veins plane* or *sunken above*, *prominent below*; *lateral veins 7–16 pairs*, *arching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation reticulate*, *veins of the fourth or fifth order are present in the form of very fine reticulations of closer than 0.1 cm mesh*, *prominulous on both surfaces*; *petiole 1–1.5 cm long*. **Male inflorescences** *c.* 0.3 cm long, each bearing 3–5 flowers, often borne on specialised reproductive short shoots of 3–6 cm long. **Male flowers** with *calyx globose* or *ovoid*, *divided at top into 3–4 valvate triangular teeth*. **Female flowers** with *calyx divided almost to base into 3–4 valvate triangular lobes*. **Fruits** usually solitary, on 0.5–1 cm long stalks (often appearing subsessile), ellipsoid, ovoid, or globose, *to c. 5 × 5 cm*, symmetric, velvety when young, becoming glabrous with age, *smooth* or *puckered*. **Fruit calyx** *accrescent*, *woody*, velvety, *rim reflexed backwards* or *spreading*; *veins very faint or invisible*.

Distribution. India, Sri Lanka, Thailand, Indo-China, Peninsular Malaysia, Borneo, and the Philippines.

Key to varieties

Leaf blade plane between veins; lateral and intercostal veins flat above........................

var. **toposia**

Distribution as the species. In Borneo rare, known by two collections from Sabah (e.g., *Keith 36*) and Kalimantan (e.g., *Niniek 607*).

Leaf blade bullate between veins; lateral and intercostal veins sunken above...............

var. **toposioides** (King & Gamble) Phengklai

(Greek, *-oides* = resembling; resembling *D. toposia*)

Thai For. Bull. 11 (1978) 36; Argent *et al.* (eds.) *l.c.* 187. Basionym: *D. toposioides* King & Gamble *l.c.* 223, Merrill *l.c.* (1929) 240, Bakhuizen *l.c.* (1938) 301, Masamune *l.c.* 606, Ng *l.c.* (1978) 89, Anderson *l.c.* 170, Turner *l.c.* 200, Coode *et al.* (eds.) *l.c.* 290, Beaman *et al. l.c.* 230. Syntypes: *Ridley 10302*, Peninsular Malaysia, Perak, Lumut (SING) and *King's Collector 4106*, Peninsular Malaysia, Perak, Larut (SING).

Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *Chew et al. 1166*, *FMS 44682*, *SAN 16142*, *SAN 77182*, and *SAN 100319*), Sarawak (common, e.g., *Hansen 1030*, *S 21314*, *S 3598*, *S 52385*, and *S 53961*), Brunei (e.g., *Atkins 509*, *BRUN 15044* and *Dransfield 6681*), and Kalimantan (e.g., *bb. 29023*, *Kostermans 8951* and *Veldkamp 8230*). In lowland and hill mixed dipterocarp forest, to 600 m altitude.

The bullate condition of the leaves and the very fine pattern of reticulations distinguishes this variety from *D. pyrrhocarpa*.

72. **Diospyros tuberculata** Bakh. Fig. 1J.

(Latin, *tuberculatus* = covered with tubercles or warts; possibly referring to the fruit)

Gard. Bull. S. S. 7 (1933) 187, *l.c.* (1938) 191; Masamune *l.c.* 606; Anderson *l.c.* 170; Beaman *et al. l.c.* 230. **Syntypes:** *Castro & Melegrito 1409*, Borneo, Sabah (K, photo) and *Amdjah 498*, Borneo, Kalimantan, Sebuku (*n.v.*).

Tree to 15 m tall. **Leaves** *membranaceous*, *not subglaucous* and glabrous to velvety *below*, often drying crinkled along intercostal veins; *elliptic*, *7–18 × 3–7.5 cm*, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; veins often black against a pale leaf under surface; *lateral veins prominent below*, *6–7 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *vaguely scalariform*; *petiole 0.5–1.2 cm long*. **Male inflorescences** slender, 1–2 cm long, each bearing 5 or more flowers. **Male flowers** with *calyx deeply divided into 4 valvate triangular tiny lobes*, each lobe *c.* 0.1 × 0.1 cm; corolla 0.2–0.4 cm long, ovoid to ellipsoid in bud. **Female inflorescences** 0.5–1.5 cm long, each bearing solitary flower, peduncles often in clusters of 2–5. **Female flowers** with *calyx divided deeply into 4 leafy broad valvate lobes with plicate margins*. **Fruits** solitary, on 0.5–1 cm long stalks, ovoid to globose, *to c. 2 cm diameter*, *often asymmetric because of one side longer and more curved than the other*, velvety, becoming glabrous and *smooth*, *somewhat puckered on drying.* **Fruit calyx** *accrescent*; *lobes leafy coriaceous*, *erect* to *spreading*, *margins undulate.*

Distribution. Endemic to Borneo and known from Sabah (very common, e.g., *SAN 26333*, *SAN 31470*, *SAN 35349*, *SAN 76338*, *SAN 93942*, and *SAN 111747*) and Kalimantan (e.g., *Amdjah 498*).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. tuberculata* resembles *D. sumatrana* in the broad leafy valvate calyx lobes of the female flowers and fruits, but the peduncles are longer, 0.5–1 cm, the fruits larger and asymmetric, with one side more curved than the other, the calyx lobes larger and more plicate, and the male flowers much smaller (lobes small and not leafy). Also, the leaves are thinner and the vein reticulation more obvious.

73. **Diospyros ulo** Merr.

(after the Philippine vernacular name—*ulo*)

Philip. J. Sci. Bot. 11 (1916) 30; Bakhuizen *l.c.* (1938) 312; Argent *et al.* (eds.) *l.c.* 187; Beaman *et al. l.c.* 231. **Type:** *Barros 23243*, the Philippines, Luzon, Cagayan Prov. (*n.v.*).

Tree to 22 m tall. **Leaves** coriaceous, glabrous (rarely velvety hairy below), *not subglaucous below*; *elliptic*, *ovate* or *obovate*, *10–20 × 5–10 cm*, *base cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominent below*, *5–8 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *laxly reticulate*; *petiole 0.6–1.2 cm long*. **Male inflorescences** to 2.5 cm long, each bearing 3 or more flowers. **Male flowers** with *calyx cup-shaped with mouth truncate* or bearing 4 small teeth. **Female inflorescences** 0.2–1.5 cm long, each bearing 3 or more flowers. **Female flowers** with *calyx truncate*, *cup-shaped*. **Fruits** in clusters of 1–4, on 0.2–1.5 cm long stalks, obovoid or globose, *to c. 5 cm diameter*, *not ribbed*, symmetric, woody and thick-walled, densely velvety, becoming glabrous. **Fruit calyx** *slightly accrescent*, *forming a shallow truncate cup* or *plate of 1.5–2 cm diameter*, or *irregularly torn and reflexed*.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *SAN A 127*, *SAN 15544*, *SAN 38206*, *SAN 43333*, *SAN 95131*, and *SAN 100576*), Sarawak (e.g., *S 32664*) and

Kalimantan (e.g., *Kostermans 5751*, *Kostermans 6943*, *Kostermans 13552*, and *Kostermans 13884*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The truncate calyx is distinctive. Specimen *SAN 95131* is exceptional in the leaves velvety hairy below.

74. **Diospyros venosa** Wall. *ex* A.DC.

(Latin, *venosus* = conspicuously veined; referring to the leaf)

Prod. Syst. Nat. 8 (1844) 233; Ng *l.c.* (1977) 246, *l.c.* (1978) 93; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Ng *l.c.* (2001) 311; Beaman *et al. l.c.* 231. **Type:** *Wallich 4126*, Penang (K-W). **Synonyms:** *D. rotundiflora* Hiern *l.c.* 163, Merrill *l.c.* (1921) 485 (*spalme* "*rotundifolia*"), Masamune *l.c.* 605; *Rhipidostigma teysmanni* Hassk., Retzia 1 (1855) 106; *Maba teysmanni* (Hassk.) Hiern *l.c.* 137, Merrill *l.c.* (1921) 484; *Maba hermaphroditica* Zoll., Syst. Verzeich. 14 (1857) 155 & 158; *D. hermaphroditica* (Zoll.) Bakh. *l.c.* (1933) 162, *l.c.* (1937) 84, Anderson *l.c.* 169; *Maba merguensis* Hiern, *l.c.* 134, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607; *Maba venosa* (Wall. *ex* A.DC.) King & Gamble *l.c.* 203; *D. bintuluensis* Kosterm. *l.c.* 453.

Tree to 20 m tall. **Twigs** velvety to glabrous. **Leaves** chartaceous to coriaceous, glabrous or densely velvety below, *drying dark brown* to *almost black*; *elliptic*, *oblong-elliptic* to *oblong-ovate*, *5–20 × 1.8–9 cm*, *base broadly cuneate* to *rounded*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous* to *prominent below*, *4–11 pairs*, *arching and diminishing toward leaf margin*; *intercostal venation laxly reticulate*; *petiole 0.5–1.3 cm long*. **Male inflorescences** 0.6–3.6 cm long, sometimes arising on special leafless twigs to 3 cm long, each bearing 1–25 minute globose flowers, sometimes many inflorescences crowded together to resemble witches brooms. **Male flowers** with *calyx divided into 3*(*–4*) *valvate lobes*; corolla globose to ovoid in bud. **Female inflorescences** 0.5–1.5 cm long, each bearing 6–many crowded flowers. **Female flowers** with *calyx divided two-thirds down into 3*(*–4*) *valvate slightly plicate triangular lobes*, the basal third forming a cup or not. **Fruits** in clusters of 1–3 or more, on 0.5–1.5 cm long stalks, ellipsoid to depressed globose, *2–2.5 × 1.5–1.8 cm*, *not ribbed*, symmetric, smooth, shiny, black, glabrous. **Fruit calyx** *not* or *slightly accrescent*, *forming a cup around the base of fruit*; *lobes leafy coriaceous*, to *c.* 0.9 × 0.5 cm, *reflexed backwards*.

Distribution. Myanmar to Vietnam, Sumatra, Peninsular Malaysia, Java, and Borneo.

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. venosa* can be confused with *D. kurzii* and *D. confertiflora.* In fruiting specimens, *D. venosa* differs from *D. kurzii* by its fruit calyx with the base forming a distinct cup below the reflexed lobes (such a cup is absent in *D. kurzii* because the lobes are divided to the base). *D. confertiflora* can be distinguished from *D. venosa* by its asymmetric fruits with consistently 3-lobed calyx, the nearly invisible venation and the membranaceous parallel-sided leaves.

Key to varieties

Lower leaf surface glabrous, or hairy only on midrib and lateral veins below..........
var. **venosa**
Distribution as the species. In Borneo, found in Sabah (e.g., *FMS 38604*, *SAN 44586*, *SAN 76248*, *SAN 125512*, and *SAN 132919*), Sarawak (common, e.g., *Clemens 20636*, *Chew CWL 518*, *S 12723*, *S 15912*, and *S 38881*), and Brunei (e.g., *S 4146*). In lowland mixed dipterocarp forest.

Lower leaf surface densely velvety...
var. **olivacea** (King & Gamble) Ng
(Latin, *olivaceus* = olive-green; alluding the colour of drying leaves)
Malay. For. 40 (1977) 247; Turner *l.c.* 200; Ng *l.c.* (2001) 311. Basionym: *Maba olivacea* King & Gamble *in* Williams, Bull. Herb. Boiss. 2, 5 (1905) 227. Type: *King's Collector 7877*, Peninsular Malaysia, Perak (K, SING). Synonyms: *D. hermaphroditica* (Zoll.) Bakh. var. *olivacea* (King & Gamble) Bakh. *l.c.* (1937) 85; *D. olivacea* (King & Gamble) Kosterm. *l.c.* 465.
Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 49536*, *SAN 53860* and *SAN 83892*) and Sarawak (e.g., *S 38590*, *S 39237*, *S 42462*, *S 42562*, and *S 59689*). In lowland mixed dipterocarp forest.

75. **Diospyros wallichii** King & Gamble Fig. 2J.

(N. Wallich, 1786–1854, Danish botanist at Calcutta, India)

In Williams, Bull. Herb. Boiss. 2, 5 (1905) 429; Bakhuizen *l.c.* (1938) 262; Ng *l.c.* (1978) 93; Anderson *l.c.* 171; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Argent *et al.* (eds.) *l.c.* 188; Ng *l.c.* (2001) 311. **Type:** *Curtis 2594*, Peninsular Malaysia, Kedah, Langkawi (SING). **Synonym:** *D. pulchrinervia* Kosterm. *l.c.* 460.

Tree to 20 m tall. **Twigs** rusty appressed hairy when young, becoming glabrous with age. **Leaves** chartaceous, glabrous to rusty-hairy below, *plane* or *bullate between veins*, *not subglaucous below*; *oblong-elliptic*, rarely *lanceolate*, (*14–*)*20–43 × 5.5–18 cm*, *base subcordate* to *rounded* or *broadly cuneate*, sometimes bearing a pair of pit-glands, *apex acuminate*; *midrib sunken* (sometimes prominulous) *above*; *lateral veins more-or-less sunken* (sometimes prominulous) *above*, *prominent below*, (*10–*)*11–30 pairs*, *diminishing toward leaf margin*; *intercostal venation vaguely scalariform*; *petiole 0.7–1.5 cm long*. **Male inflorescences** slender, *1–2 cm long*, each bearing to 9 flowers. **Male flowers** with *calyx divided into 4 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** *0.7–2.5 cm long*, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate lobes*. **Fruits** in clusters of 1 or more, on 0.5–2 cm long stalk, *globose*, *to c. 2.5 cm diameter*, *not ribbed*, *symmetric*, often with small pointed tip in the centre of a depressed apex, densely rusty velvety. **Fruit calyx** *accrescent*, *woody*, *densely rusty velvety*; *lobes short*, *erect but the sides often dilated and reflexed.*

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (e.g., *SAN 25227*, *SAN 30856*, *SAN 83521*, *SAN 87816*, and *SAN 93812*), Sarawak (common, e.g., *S 16721*, *S 23318*, *S 33915*, *S 49198*, and *S 54756*), Brunei (e.g., *BRUN 448*, *BRUN 15145*, *SAN 17399*, *SAN 17407*, and *Wong WKM 228*), and Kalimantan (e.g., *Kostermans 9785*, *Kostermans 9951* and *Kostermans 21583*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude, and on limestone hills.

Notes. In other parts of its range, the spaces between the calyx lobes of the fruits are filled with a proliferated callus tissue, but such tissue is absent or only present in slight amount in the Bornean specimens. *D. pulchrinervia* is merely a specimen with extremely bullate leaves.

EXCLUDED SPECIES

Diospyros sororia Bakh. *l.c.* (1936–41) 125. **Type:** *Sitam 00046*, Borneo, Sarawak = ***Ilex borneensis Loes. (cf. Ng, Blumea 18 (1970) 412).***

LECYTHIDACEAE

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King, J. As. Soc. Beng. 70, 2 (1901) 134 (under Myrtaceae); Merrill, EB (1921) 418; Ridley, FMP 1 (1922) 756 (under Myrtaceae); Knuth, Pflanzenreich 105 (1939) 1; Masamune, EPB (1942) 513; Backer & Bakhuizen *f.*, FJ 1 (1964) 351; Payens, Blumea 15 (1967) 157; Whitmore, TFM 2 (1972) 257; Anderson, CLTS (1980) 230; Cockburn, TS 2 (1980) 44; Corner, WSTM 3rd. edition 1 (1988) 386; Ng, MFFSS (1991) 415; Kessler & Sidiyasa, TBSA-EK (1994) 159; Turner, Gard. Bull. Sing. 47 (1995) 286; Chantaranothai, Kew Bull. 50 (1995) 677, *ibid.* 695; Coode *et al.* (eds.), CLBD (1996) 158; Argent *et al.* (eds.), MNDT-CK 1 (1997) 332; Beaman *et al.*, PMK 4 (2001) 419.

Trees. **Leaves** spirally arranged, simple, usually without stipules (infrequently with minute, caducous stipules), clustered or scattered at branch ends, penniverved. **Flowers** solitary or in spikes or racemes, axillary or terminal, radially (all Bornean species) or bilaterally symmetrical, 4–8-merous, bisexual; calyx 4–8-lobed, free or fused to corolla; corolla usually present, 4–6-lobed, less frequently absent; stamens numerous, filaments fused at base into a staminal tube, the tube radially symmetrical (all Bornean species) or prolonged on one side into a strap-like structure with arches over the summit of the ovary, in some apetalous species the outermost stamens modified into a petaloid corona; anthers basifixed, dehiscing along a longitudinal suture; intrastaminal disc present or absent; ovary inferior to half-inferior; ovules anatropous to apotropous, placentation axial. **Fruits** fibrous berries, dry drupes, or woody circumscissile capsules with one to many seeds. **Seeds** with or without cotyledons, with leathery seed coats; endosperm scanty or absent; germination hypogeal for species without cotyledons, epigeal for species with cotyledons.

Distribution. About 25 genera and 400 species, with pantropical distribution. The family is generally subdivided into four subfamilies, with members of the subfam. Planchonioideae (6 genera, 55 species) ranging from Africa to Australia; subfam. Foetidioideae (1 genus, 5 species) from Madagascar to Peninsular Malaysia; subfam. Napoleonaeoideae (3 genera, 12 species) from West Africa to S America; and subfam. Lecythidoideae (10 genera, *c.* 212 species) confined to C and S America. In Sabah and Sarawak, the family is represented by 2 genera with 23 species, all belonging to the subfam. Planchonioideae.

Ecology. In Borneo, common in lowland mixed dipterocarp forests. Many species are found in wet habitats (e.g., swamp, littoral and alluvial forests) and some species occur in well-drained forests.

Uses. Trees have large showy flowers which make them valuable as ornamentals. The timber of some species is used locally for construction. The roots, bark, leaves, fruits and seeds of some species are used in traditional medicine. Bark of some species is used as fish poison.

Taxonomy. Traditionally, the Lecythidaceae was aligned with the Myrtaceae, probably owing to its alternate leaves with minute stipules, myrtalian chemical characteristics (i.e., triterpene, saponins and ellagic acid), and numerous stamens. However, a lack of internal phloem and vestured pits while possessing centrifugal development of the stamens, showy imbricate petals, and various embryological features suggest the family is affiliated with the Theales, specifically Theaceae, Ochnaceae, Scytopetalaceae, Ebenaceae, and Styracaceae.

Although the genera in the family have been aggregated and segregated in various ways in the past, one family with four subfamilies is currently recognised. The subfamilies are distinguished by pollen type (syntricolpate, tricolpate or tricolporate), the orientation of the cortical bundles, and the presence or absence of the followings: crystal chains in the secondary xylem, petals, and a corona of staminal origin. As circumscribed, the Lecythidaceae is paraphyletic; the subfam. Planchonioideae and subfam. Lecythidoideae make a monophyletic group with *Gustavia* L. and *Grias* L. of the New World Lecythidoideae being the link between the New and Old World Lecythidaceae.

Key to genera

Leaves generally whorled, tufted or clustered at ends of twigs; base mostly cuneate, non-decurrent; midrib usually prominent on both sides. Petioles thickened at insertion. Inflorescences terminal, axillary, or borne on leafless older branches, generally pendulous and long (more than 20 cm long), rarely erect and short, mostly many-flowered. Ovules pendent, 2–6(–13) per locule, inserted at the apical part of placentation axis. Fruits one-seeded (4–6-seeded in *B. hallieri*); embryo solid, spindle-shaped, without cotyledons
.... **1. Barringtonia**

Leaves generally well-spaced along twigs; base attenuate, decurrent, often extending down along the entire length of petiole; midrib prominent beneath, flattened above. Petioles not thickened at insertion. Inflorescences terminal, generally short (less than 15 cm long), mostly erect and few-flowered. Ovules, horizontal, numerous per locule, inserted along the entire length of placentation axis. Fruits (1–)3–15(or more)-seeded; embryo coiled, with folded foliaceous cotyledons...**2. Planchonia**

1. **BARRINGTONIA** J.R. & G.Forst.

(D. Barrington, 1727?–1800, an English naturalist)

Char. Gen (1776) 75; King, J. As. Soc. Beng. 70, 2 (1901) 134; Ridley, FMP 1 (1922) 756; Burgess, TBS (1966) 340; Backer & Bakhuizen *f.*, FJ 1 (1964) 352; Burkill, EPMP 1 (1966) 306; Payens, Blumea 15 (1967) 175; Whitmore, TFM 2 (1972) 260; Anderson, CLTS (1980) 230; Cockburn, TS 2 (1980) 44; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 190; Ng, MFFSS (1991) 417; Kessler & Sidiyasa, TBSA-EK (1994) 159; Chantaranothai, Kew Bull. 50 (1995) 677 & 695; Coode *et al.* (eds.), CLBD (1996) 158; Argent *et al.* (eds.), MNDT-CK 1 (1997) 332; Beaman *et al.*, PMK 4 (2001) 419. **Synonyms:** *Butonica* Lam., Enc. Méth. Bot. I, 2 (1785) 521; *Stravadium* Juss., Gen. Pl. (1789) 326; *Michelia auct. non* L.: Kuntze, Rev. Gen. Pl. I (1891) 240; *Careya* sect. *Barringtoniopsis* Nied. *in* K. Schumann, Notizbl. Bot. Gart. Berl. 2 (1898) 137.

Trees or shrubs with a wide range of growth forms, generally without buttresses. Shoots with episodic growth, young twigs with prominent leaf scars. **Stipules** distinct at base of young leaves, cauducous. **Leaves** *mostly whorled*, *tufted* or *clustered at ends of twigs*, rarely also persistent proximally; *base cuneate*, *non-decurrent*; *midrib tends to be prominent on both sides of leaf*; *petiole generally thickened at insertion*. **Inflorescences** *axillary*, *terminal*, or *borne on leafless older branches* or stems, *many-flowered* spikes or racemes, unbranched and *mostly pendulous and long*, *rarely erect and short*; bracts often early caducous. **Flowers:** hypanthium funnel-shaped, tetrangular, or subglobular, often extending into a pedicel, articulated at base near rachis; sepals generally chartaceous, either connate or free in bud; petals 3–5, imbricate, convex, adnate to staminal tube at base; stamens numerous, longer than petals, in 3–8 whorls, inner whorl(s) reduced to sterile filaments; filaments fused at base into a tube; anthers basifixed, 2-loculed, latrorse; intrastaminal disk a thin or thick undulating ring around the base of style; ovary inferior, 2–4-loculed, style usually as long as stamens, persistent; stigma knob-like or lobed; *ovules attached apically* and axially, *pendent*, anatropous to apotropous, *2–6*(*–13*) *per locule*, usually only one developed into seed in each fruit (except for *B. hallieri*, where 4–6 ovules developed into seeds). **Fruits** drupaceous, in cross-section angled, winged or rounded; pericarp usually fleshy-leathery outside and woody or fibrous inside; calyx persistent. **Seeds** *1* (*exceptionally 4–6 in B. hallieri*) *per fruit*, large; testa brown, membranaceous; *embryo solid*, *spindle shaped*, *without cotyledons*; germination hypogeal.

Vernacular names. Sabah—*putat* (Malay), *tampalang* (Dusun). Sarawak—*karut*, *langkong* (Iban).

Distribution. In tropical and subtropical regions of E Africa, Madagascar, Asia, Malesia, Australia and the Pacific Islands. In Sabah and Sarawak, 20 species are recorded.

Ecology. In Borneo, the genus is common in lowland and hill mixed dipterocarp forests, swamp forest, mangroves and along the coast in the littoral zone, at altitudes to 2000 m. The fruits of some species are bouyant and perhaps are dispersed by water, while those of many other species have a fleshy mesocarp and probably are dispersed by mammals.

Uses. Most species of *Barringtonia* have saponins in its various tissues, the highest concentration being found in seeds though bark, wood and roots are used as a source of saponin. The saponins are frequently used as fish poisons, as a tanning agent, or medicinally for poulticing. Young leaves of some species are eaten raw. Timber is generally not used as it is not durable.

Taxonomy. The genus has been variously subdivided, most recently (Payens *l.c.*) into two sympatric sections, *i.e.* sect. *Barringtonia* and sect. *Stravadium*, based on the structure of the calyx in bud, whether lobes are connate or free. Based on morphological and embryological characters, *Barringtonia* appears to be one of the least derived genera within the subfam. Planchonioideae.

Key to *Barringtonia* species

1. Coastal plants, in littoral or mangrove forests or on tidal riverbanks near the limit of saline influence..2
   Inland plants, in swamp forest, riverine forest, lowland or hill mixed dipterocarp forest..4

2. Leaves subcoriaceous, margin entire; lateral veins 6–10 pairs. Fruits ovoid, angular, sharply tapering towards apex, without wings............................**3. B. asiatica**
   Leaves chartaceous, margin serrate-crenulate or minutely denticulate; lateral veins 10–20 pairs. Fruits conical, ovoid or with distinct wings..............................3

3. Leaf base auriculate or emarginate, apex rounded or emarginate, rarely acute. Hypanthium cylindrical, with 8 wing-like appendages at base. Fruits conical with 8 distinct wings..**4. B. conoidea**
   Leaf base cuneate, apex acute or acuminate. Hypanthium long, funnel-shaped, often extending into a pseudopedicel. Fruits ovoid, subtetragonous, slightly winged when young..**15. B. racemosa** (in part)

4. Lateral veins 35–45 pairs. Petiole 9–20 cm long..........................**7. B. hallieri**
   Lateral veins less than 35 pairs, or if more than 35 pairs, then petiole less than 9 cm long...5

5. Twigs stout, with a diameter of more than 10 mm.....................................6
   Twigs slender, with a diameter of less than 10 mm....................................9

6. Twigs and inflorescence rachises distinctly winged.....................................
   ....**6. B. gigantostachya** (var. **megistophylla**)
   Twigs and inflorescence rachises not distinctly winged....................................7

7. Leaf margin almost entire, revolute....................................**19. B. sarcostachys**
   Leaf margin serrate-crenulate to minutely denticulate....................................8

8. Leaves in two or more whorls at ends of twigs, obovate-lanceolate or linear-lanceolate. Inflorescence rachis glabrous...**11. B. macrocarpa**
   Leaves not tufted or clustered at ends of twigs, obovate-oblong or obovate-lanceolate. Inflorescence rachis covered with tawny powdery granules........**5. B. curranii** (in part)

9. Leaves coriaceous or subcoriaceous..10
   Leaves chartaceous...16

10. Inflorescence a spike..11
    Inflorescence a raceme..14

11. Inflorescences borne on leafless older twigs...12
    Inflorescence terminal..13

12. Spike rachis 5–6 mm diameter increasing to 15 mm; hypanthium with distinct grooves but not winged on edges.................................**13. B. pendula** (in part)
    Spike rachis 3–7 mm diameter; hypanthium with distinctly winged edges...**20. B. scortechinii** (in part)

13. Leaves drying grey-green above, yellowish brown beneath.....**2. B. ashtonii** (in part)
    Leaves drying concolourous...**16. B. reticulata**

14. Petiole rugose, thick, and slightly winged..............................**17. B. revoluta**
Petiole otherwise...15

15. Leaves oblong to obovate-lanceolate; petiole 2–5 cm long..............**10. B. longisepala**
Leaves elliptic, narrow elliptic to obovate; petiole 0.6–1.2 cm long..........................
....**18. B. sarawakensis** (in part)

16. Inflorescence a spike...17
Inflorescence a raceme..25

17. Spikes erect..**9. B. lanceolata**
Spikes pendulous..18

18. Lateral veins 15 pairs or more. Inflorescence rachis 5 mm or more in diameter at base...
....19
Lateral veins less than 15 pairs, if more than 15 pairs, the inflorescence rachis is less than 5 mm in diameter at base..22

19. Inflorescence rachis glabrous..20
Inflorescence rachis covered with tawny powdery granules........................21

20. Leaf margin shallowly serrate-crenulate, not revolute. Hypanthium tetragonous, hard, 4–6 mm long, glabrous..**12. B. macrostachya**
Leaf margin entire or serrate-crenulate towards apex, often revolute. Hypanthium subterete to tetragonous, with 4 distinct grooves on corners, 6–12 × 5–8 mm, ferruginous pubescent...**13. B. pendula** (in part)

21. Spikes terminal..**5. B. curranii** (in part)
Spikes borne on leafless older twigs..........................**13. B. pendula** (in part)

22. Calyx lobes free in bud....................................**20. B. scortechinii** (in part)
Calyx lobes connate in bud...23

23. Lateral veins less than 15 pairs. Flower buds *c.* 5 × 5 mm or smaller.................
....**2. B. ashtonii** (in part)
Lateral veins more than 15 pairs, or if less than 15 pairs, flower buds larger than 5 × 5 mm...24

24. Hypanthium tetragonous, sharply angled or winged...........**14. B. pterita** (in part)
Hypanthium funnel-shaped without angles or wings.........**15. B. racemosa** (in part)

25. Twigs flaky or ridged. Bracts at base of inflorescence (cataphylls) persistent.........
....**1. B. acutangula** (subsp. **acutangula**)
Twigs not obviously flaky or ridged. Bracts at base of inflorescence (cataphylls) caducous..26

26. Leaf margin serrate-crenulate...27
Leaf margin entire to finely crenulate.....................**18. B. sarawakensis** (in part)

27. Hypanthium tetragonous, sharply angled or winged..........**14. B. pterita** (in part)
    Hypanthium funnel-shaped or tubular, often extending into a pseudopedicel...28

28. Flower buds often mucronate; calyx lobes connate in bud......**15. B. racemosa** (in part)
    Flower buds not mucronate; calyx lobes free in bud......................**8. B. havilandii**

1. **Barringtonia acutangula** (L.) Gaertn.

(Latin, *acutangularis* = sharp-angled; the fruit)

Fruct. Sem. Pl. 2 (1791) 97, *t.* 101; Payens *l.c.* 226; Anderson *l.c.* 230; Corner, WSTM 3rd. edition 1 (1988) 353; Whitmore, Tantra & Sutisna *l.c.* 191; Turner, Gard. Bull. Sing. 47 (1995) 287; Chantaranothai *l.c.* 680; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *Eugenia acutangula* L., Fl. Zeyl. (1748) 85, no. 190, Sp. Pl. (1753) 471. **Lectotype** (Payens, 1967)**:** *Herb. Hermann 190*, "Ceylon" (hololectotype BM). **Synonyms:** *Stravadium acutangulum* (L.) J.St.-Hil., Exp. Fam. 2 (1805) 24, *excl. syn.*; *Michelia acutangula* (L.) Kuntze, Rev. Gen. Pl. 1 (1891) 240; *Huttum acutangulum* (L.) Britten, J. Bot. 39 (1901) 67; *B. spicata* Blume, Bijdr. Fl. Ned. Ind. (1826) 1099; *S. spicatum* (Blume) Blume *in* DC., Prod. 3 (1828) 289; *M. spicata* (Blume) Kuntze *l.c.* 241; *B. micrantha* Gagn., Not. Syst. 3 (1914) 385; *B. pedicellata* Ridl. *l.c.* (1922) 759; *B. martensii* Knuth, Pflanzenreich 105 (1939) 46, Masamune, EPB (1942) 514. (For complete synonyms see Payen *l.c.* 226).

Distribution. Afghanistan, Pakistan, India, Bangladesh, Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Timor, New Guinea, and N Australia. In Sabah, known from Sandakan district (e.g., *SAN 24755* and *SAN 85356)* and in Sarawak from Miri district (e.g., *S 39158* and *S 44803*). Also occurs in Brunei (e.g., *Niga NN 12*, *Kirkup 355* and *Wong WKM 621*) and E Kalimantan.

subsp. **acutangula**

Tree to 15(–25) m tall, 7–20 cm diameter. **Bark** grey or brown, fissured. **Twigs** *slender*, *3–5 mm diameter*, *usually flaky* or *ridged*, usually glabrous. **Leaves** *chartaceous*, glabrous or hairy beneath; elliptic or obovate-oblong, (5–)6–16(–31) × 2–6(–9.5) cm, margin finely serrate-crenulate, apex obtuse, acute, or acuminate; *lateral veins* (*7–*)*10–12*(*–20*) *pairs*; *petiole 0.4–1*(*–1.5*) *cm long*. *Cataphylls* (bracts at the base of inflorescence) triangular, 1.5–6 × 1–3.5 mm, *persistent*. **Inflorescences** *racemose*, terminal, pendulous, main rachis 20–45(–78) cm long, 1–2 mm diameter at base, glabrous, slightly fissured; bracts elliptic-lanceolate, 1–5 × 0.75–2 mm. **Flowers:** buds *c.* 5 × 5 mm; hypanthium tubular, tetragonous, glabrous, extending into pedicels (1–)3–17 mm long, to 1 mm diameter; calyx lobes free in bud, semicircular, 2–3.5 × 1.5–3 mm, chartaceous, obtuse; petals 6–10(–12) × 4–7 mm, elliptic, obtuse, convex; staminal tube 1–4.5 mm high; stamens in 3 whorls; disk *c.* 0.5 mm high; ovary 2(–3–4)-loculed, 4(–5)-gonous, style 10–20 mm long, ovules 2–4(–5) per locule. **Fruits** angled or ovoid or subglobular, 2–6 × 1–3 cm, 4-winged when young, apex truncate, base emarginate or tapering; pericarp 3–6 mm thick. **Seeds** ovoid, grooved, 1–4 cm long.

Vernacular names. Sabah—*tampalang* (Dusun). Sarawak—*langkong* (Iban), *putat* (Malay). Brunei—*jempalang* (Dusun), *langkong* (Iban), *putat* (Malay).

Distribution. As the species.

Ecology. In lowland mixed dipterocarp forest.

Uses. The bark is used as a fish poison; the leaves, bark and fruit are used in traditional medicine.

Notes. Payens (*l.c.*) reduced many bionomials to two subspecies of *B. acutangula*, one with pedicellate flowers and angled fruits (subsp. *acutangula*) and one with sessile flowers and globular to slightly winged fruits (subsp. *spicata* (Blume) Payens). Disagreement over the reduction exists (e.g., Corner *l.c.*) but palynological data supports designation as one species only (Payens *l.c.*). The variability in the hypanthium or calyx tube found in this widely distributed species argues against subspecies distinctions. However, it appears that the Bornean population belongs to subsp. *acutangula* and are small, single-stemmed trees tending to occur in lowland mixed dipterocarp forest. The Peninsular Malaysian population, on the other hand, represents subsp. *spicata*, tending to be multiple-stemmed, and are more often found near rivers, in swamp and mangrove forests.

2. **Barringtonia ashtonii** Payens

(P.S. Ashton, former Forest Botanist at the Forestry Departments of Brunei and Sarawak; Charles Bullard Professor of Forestry, Harvard University, U.S.A.)

Blumea 15 (1967) 218; Anderson *l.c.* 230; Cockburn *l.c.* 47; Whitmore, Tantra & Sutisna *l.c.* 191. **Type:** *Kostermans 5289*, Borneo, Kalimantan (holotype L; isotype BO).

Tree to 17 m tall, 10–45 cm diameter. **Bark** brown, scaly and dippled; inner bark brown. **Sapwood** whitish yellow. **Twigs** *slender*, *2–5 mm diameter*. **Leaves** clustered at ends of twigs, *subcoriaceous* to *chartaceous*, glabrous, *drying grey-green above*, *yellowish brown beneath*; elliptic, ovate, or oblong, (8–)10–15(–21) × (3–)4–6(–9) cm, base cuneate, decurrent, margin entire to crenulate, apex acuminate or cuspidate; *lateral veins 7–12 pairs*; *petiole 1–3*(*–4.5*) *cm long*, 1–2 mm diameter. Cataphylls triangular, 5–7 × 3–4 mm. **Inflorescences** *spicate*, *terminal*, *pendulous*, *main rachis* (15–)30–77 cm long, *0.5–3 mm diameter at base*, glabrous or sparsely covered with powdery granules, many-flowered; bracts linear-lanceolate, 10–12 × 1.5–2 mm. **Flowers:** *buds 4–5 × 4–5 mm*; hypanthium tetragonous with 4 ribs, 3–4 mm long, 1–1.5 mm wide, glabrous; *calyx lobes connate in bud*, rupturing into 2–3 equal, ovate, mucronate lobes, 6–8 × 4–6 mm; petals 4, 11–13 × 6–8 mm, obtuse or rounded; stamens in 3–4 whorls, staminal tube 1–2 mm high; disk thick, 0.5–2 mm high; ovary 3(–4)-loculed, style filiform, 22–28 mm long, ovules 1–2 per locule. **Fruits** ovoid, 4.5–5 × 2–3 cm, tapering towards apex and base, rugose, 4-ribbed; pericarp 1.5–2 mm thick. **Seeds** ovoid, *c.* 2.7 cm long.

Vernacular name. Sabah—*tampalang* (Dusun).

Distribution. Endemic to Borneo. In Sabah, recorded from Tawau, Sandakan and Lahad Datu districts (e.g., *SAN A* 3988, *SAN 30658*, *SAN 53023*, *SAN 71658*, *SAN 79863*, *SAN 82130*, *SAN 94885*, and *Stevens 422*), and in Sarawak from Miri district (e.g., *S 27027*). Also occurs in Kalimantan (e.g., *Kostermans 5289* and *Kostermans 13352*).

Ecology. Along rivers in inland lowland mixed dipterocarp forest.

3. **Barringtonia asiatica** (L.) Kurz
(of Asia)

Rep. Pegu (1875) App. A, lxv, App. B, 52 *in clavi*; Merrill, EB (1921) 418; Burkill *l.c.* 304; Payens *l.c.* 184; Whitmore *l.c.* 258; Anderson *l.c.* 230; Cockburn *l.c.* 45; Corner *l.c.* 391; Whitmore, Tantra & Sutisna *l.c.* 191; Turner *l.c.* 288; Chantaranothai *l.c.* 682; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *Mammea asiatica* L., Sp. Pl. (1753) 512. **Type:** *Osbeck s.n.*, "Prinsen Is., off W Java" (holotype LINN; isotype S). **Synonyms:** *B. speciosa* J.R. & G.Forst. *l.c.* 76, Merrill *l.c.* (1921) 418; *Commersona speciosa* (J.R. & G.Forst.) Salisbury, Prod. (1796) 355; *Agasta asiatica* (L.) Miers, Trans. Linn. Soc. Bot. 1 (1875) 61; *Butonica asiatica* (L.) J.St.-Hil. *l.c.* 166; *Huttum speciosum* (J.R. & G.Forst.) Britten *l.c.* 67. (For complete synonymy see Payens *l.c.* 185).

Tree with spreading branches, 7–20(–30) m tall, 25–100 cm diameter; bole often crooked, sometimes buttressed. **Bark** brown or grey, grooved and fissured, covered with diamond-shaped lenticels. **Sapwood** white to pale yellow; heartwood not distinct from sapwood. **Twigs** stout, 6–10 mm diameter, with large leaf scars. **Leaves** clustered at ends of twigs, *subcoriaceous*, glabrous; obovate or obovate-oblong, (15–)20–38(–52) × (7–)10–18(–21) cm, *margin entire*, apex emarginate to mucronate; *lateral veins 6–10 pairs*; petiole *c.* 0.5 cm long. Cataphylls 13–30 × 7–10 mm. **Inflorescences** racemose, terminal, rarely lateral near top of branches, erect, main rachis 2–15(–20) cm long, 8–10 mm diameter at base, glabrous, few–many-flowered; bracts sessile, ovate, 8–15(–20) × 4–10(–15) mm. **Flowers:** buds 20–40 × 20–40 mm; hypanthium tetragonous or slightly winged to subglobular, glabrous, 5–9 mm long, extending into pedicels 4–6(–9) cm long; calyx lobes connate in bud, rupturing into 2 persistent unequal segments, 3–4 × 2–3 cm; petals 55–85 × 25–45 mm, elliptic, convex; stamens in 6 whorls, staminal tube 1.5–6 mm high; disk thick, glabrous, *c.* 1 mm high; ovary 4(–5)-loculed, style 9–13.5 cm long, ovules 4(–5) per locule. **Fruits** *ovoid*, 8.5–11 × 8.5–10 cm, *angular*, *sharply tapering towards apex*, tetragonous to emarginate at base, *without wings*; pericarp with thin, shiny exocarp and thick, spongy mesocarp. **Seeds** oblong, 4–5 cm long.

Vernacular name. Sabah and Sarawak—*putat laut* (Malay).

Distribution. From Madagascar to Sri Lanka, throughout Malesia, N Australia to the Pacific Islands. In Sabah, recorded from Sandakan district (Kuala Penyu; e.g., *SAN 86142*, *SAN 114975* and *SAN 115264*), and in Sarawak from Kuching district (e.g., *S 17828*). Also occurs in Brunei (e.g., *Zainal FD. M.M.S. 30360* and *van Niel 3973*) and Kalimantan.

Ecology. A littoral or strand species with water-dispersed fruits.

Uses. Fruits are pulped and thrown into streams as a fish poison. Bark, leaves, and fruit are used in the treatment of backache and sores joints. The tree is apparently of little value for its timber.

4. **Barringtonia conoidea** Griff.
(Latin, *conoideus* = almost conical; the fruit)

Not. Pl. As. 4 (1854) 656; King *l.c.* 136; Merrill *l.c.* (1921) 419; Ridley *l.c.* (1922) 757; Burkill *l.c.* 305; Payens *l.c.* 189; Whitmore *l.c.* 258; Anderson *l.c.* 230; Corner *l.c.* 391; Whitmore, Tantra & Sutisna *l.c.*

191; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 158. **Type:** *Griffith Kew Distr. No. 2423*, "Malaya" (holotype K; isotype P).

Small tree or shrub, 3–15 m tall, 10–15 cm diameter. **Twigs** 4–10 mm diameter. **Leaves** *chartaceous*, glabrous; broadly obovate-oblong, 12–28 × (4–)7–10 cm, *base auriculate* or *emarginate*, *margin serrate-crenulate*, revolute when dry, *apex rounded*, *emarginate* or *rarely acute*; *lateral veins 10–15 pairs*, prominent beneath; petiole 0.1–0.4(–0.7) cm long, slightly winged. Cataphylls triangular-lanceolate, 5–10 × 3–4.5 mm. **Inflorescences** racemose, terminal or borne on leafless older twigs, pendulous, main rachis (2–)5–10(–60) cm long, *c.* 2 mm diameter at base, fissured, puberulous; bracts triangular, acute, *c.* 5 × 2 mm, caducous. **Flower:** buds 4–8 × 5–8 mm; *hypanthium cylindrical, with 8 wing-like appendages at base*, *c.* 3 mm long, glabrous or covered with powdery granules; pedicel 5–10 mm long, *c.* 1 mm diameter, growing to 20 mm long with fruit maturation; articulation at rachis or slightly up the flower stalk; calyx lobes connate in bud, rupturing into 2 equal ovate segments, 8–13 × 7–10 mm, subpersistent; petals *c.* 16 × 8 mm, elliptic, obtuse, convex; stamens in 5(–6) whorls, staminal tube *c.* 3 mm high; disk 0.7–2 mm high, thin; ovary 4-loculed, style 25–33 mm long, ovules 1–3 per locule. **Fruits** *conical*, 3–5 × 2.5–3.5 cm, *with 8 distinct wings*, wings 1.2–1.7 × 0.6–1.3 cm, base and apex gradually tapered; pericarp *c.* 4 mm thick. **Seeds** ovoid, *c.* 3 cm long, fissured, apex pointed, base rounded.

Vernacular name. Sarawak—*putat sungai* (Malay).

Distribution. Myanmar, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sarawak (Bintulu; e.g., *S 18586*), Brunei (Belait; e.g., *BRUN 5073* and *BRUN 5382*) and Kalimantan.

Ecology. In mangrove forest at the limit of saline influence; along the tidal zones of rivers behind the *Nypa*-zone. Generally rare although it can be locally common, often growing in thickets with *Gluta velutina* Blume (Anacardiaceae).

5. **Barringtonia curranii** Merr.

(H.Mc. Curran, 1875–?, forest officer of the Bureau of Forestry, Manila, the Philippines)

Philip. J. Sci. 1 (1906) Suppl. 211; Merrill *l.c.* (1921) 419; Masamune *l.c.* 513; Payens *l.c.* 255; Anderson *l.c.* 230; Cockburn *l.c.* 46; Whitmore, Tantra & Sutisna *l.c.* 191; Kessler & Sidiyasa *l.c.* 160; Beaman *et al. l.c.* 419. **Type:** *Curran 3596*, the Philippines, Palawan (isotype K). **Synonym:** *B. rhodochlamys* Airy Shaw, Kew Bull. (1950) 137.

Small to medium-sized tree with straight stem, (2–)13–25 m tall, 10–40 cm diameter. **Bark** grey, greyish green or dark brown, pitted, smooth or flaky; inner bark fibrous, yellow. **Sapwood** yellow or white. **Twigs** *slender* or *stout*, (*5–*)*10–18 mm diameter*, *not distinctly winged*. **Leaves** *not tufted* or *clustered at ends of twigs*, *chartaceous*, usually glabrous but sometimes hairy beneath; *obovate-lanceolate* or *obovate-oblong*, 24–70(–90) × 9–13(–21) cm, base cuneate to decurrent, *margin serrate-crenulate*, apex acuminate or obtuse; *lateral veins* (*15–*)*18–26*(*–30*) *pairs*; *petiole 0.5–1*(*–2.5*) *cm long*, 7–10 mm thick. Cataphylls triangular, lanceolate, 7–20 × 4 mm. **Inflorescences** *spicate*, *terminal*, *pendulous*, *rachis* 40–100(–110) cm long, (*5–*)*10–15 mm diameter at base*, *covered with tawny powdery granules*, *not distinctly winged*, many-flowered. **Flowers:** buds 7–12 × 7–12 mm; hypanthium tetragonous, 6–8 × 4–7 mm, thickened at base, covered with tawny powdery granules, calyx lobes free in bud, ovate-orbicular, covered with reddish brown powdery granules outside, 4–7 × 4–11 mm, fimbricate; petals 27–35 × 12–20 mm, elliptic, obtuse, convex; stamens in 5(–6) whorls, staminal tube *c.* 4–5 mm high; disk annular, undulating, grooved, 1–1.5 mm high; ovary 4-loculed, style filiform, 4–7 cm long, ovules 4–7 per locule. **Fruits** ovoid, 7–11 × 4–7.5 cm, subtetragonous or terete, tapering at both ends, covered with reddish brown powdery granules; pericarp 5–10 mm thick. **Seeds** ovoid, fissured, 4–5 cm long.

Distribution. Borneo and the Philippines (Palawan). In Sabah and Sarawak, common (e.g., *RSNB 86*, *SAN 20436*, *SAN 34592*, *SAN 49914*, *SAN 68248*, *SAN 78744*, and *SAN 118982*). Also occurs in Brunei and Kalimantan.

Ecology. In mixed dipterocarp and lower montane forests from sea level to 1700 m altitude.

6. **Barringtonia gigantostachya** Koord. & Valeton

(Greek, *giganto-* = very large, *stachys* = spike; referring to the inflorescence)

Bull. Inst. Bot. Buitenz. 2 (1899) 9. **Lectotype** (Payens, 1967)**:** *Koorders 5403*, Java (hololectotype L).

Distribution. Borneo and Java.

var. **megistophylla** (Merr.) Payens

(Greek, *megisto-* = very large, *phullon* = leaf)

Blumea 15 (1967) 206; Cockburn *l.c.* 45; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *B. megistophylla* Merr., PEB (1929) 213, Knuth *l.c.* 22. **Type:** *Elmer 21823*, Borneo, Sabah, Tawau (holotype lost; isotypes BM, BO, BRI, K, L, P, SING, U).

Small tree, 10–15 m tall, 20–40 cm diameter; bole often crooked or irregular. **Bark** smooth, superficially fissured; inner bark *c.* 10 mm thick, greyish white. **Sapwood** yellow. **Twigs** *stout*, *15–20 mm diameter*, *distinctly winged*, wings 3–5 mm wide. **Leaves** chartaceous or subcoriaceous, glabrous; obovate-lanceolate, rarely obovate-oblong, (30–)40–75(–106) × (9–)11–19(–24) cm, base decurrent, margin crenulate, apex cuspidate or obtuse; *lateral veins* (*22–*)*25–30*(*–40*) *pairs*; *petiole 0.5–1*(*–2*) *cm long*, 8–10 mm diameter. Cataphylls lanceolate or triangular, 15–90 × 5–15 mm. **Inflorescences** spicate, terminal, pendulous, *rachis* 60–125 cm long, 7–20 mm diameter at base, *fissured*, *distinctly winged* with the wings in pairs beneath flowers, 15–45 × 5 mm; bracts, narrow-triangular, serrate, 3–20 × 2–8 mm. **Flowers:** buds 8–15 mm; hypanthium subglobular to tetragonous, 4–10 mm long, glabrous; calyx lobes connate in bud with apical pore, rupturing into 3–4(–5) unequal lobes, 5–15 × 6–15 mm; petals 20–35 × 15–20 mm, fleshy, elliptic, obtuse, convex; stamens in 5–6 whorls, staminal tube 4–10 mm high; disk annular, undulating, grooved, 1–2 mm high; ovary 4-loculed, style 40–50 mm long, ovules 4–7 per locule. **Fruits** ovoid, 8.5–10 × 3–4.5 cm, tapering at both ends, glabrous; pericarp 3–5 mm thick. **Seeds** ovoid, distinctly fissured, *c.* 5 cm long.

Distribution. This variety is known only from Sabah (Kinabatangan, Kota Belud, Lahad Datu, Sandakan, and Tawau districts; e.g., *SAN 15379*, *SAN 59116*, *SAN 83166*, *SAN 112076*, and *SAN 118982*) and Kalimantan (e.g., *Kostermans 5585* and *Kostermans 13301*). The other known variety, *B. gigantostachya* var. *gigantostachya*, occurs in C Java.

Ecology. In mixed dipterocarp forest, uncommon.

Notes. This variety differs from var. *gigantostachya* by having winged rachis, with the wings inserted in pairs underneath each flower. The two varieties do not overlap in distribution.

7. **Barringtonia hallieri** Knuth

(J.G. Hallier, 1868–1932, a German botanist)

Pflanzenreich 105 (1939) 34; Masamune *l.c.* 513; Payens *l.c.* 240; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 191. **Type:** *Hallier 3067*, Borneo, Kalimantan, W Kutai (holotype L).

Small tree to 5 m tall, 6 cm diameter. **Twigs** stout, 8–20 mm diameter. **Leaves** tufted towards ends of branches but also extending down the twigs, subcoriaceous to chartaceous, glabrous; lanceolate or obovate-lanceolate, *28–68* × 5.5–19 cm, base occasionally decurrent, margin entire to finely serrate-crenulate, apex caudate or narrowly acute; *lateral veins 35–45 pairs*; *petiole 9–20 cm long*, *c.* 3 mm diameter, swollen at base. **Inflorescences** racemose, terminal, pendulous, rachis *c.* 75 cm long, 4–6 mm diameter at base, accresent to 12 mm, glabrous, slightly fissured. **Flowers:** buds 12–15 mm long; hypanthium campanulate, slightly 4-gonous, 8–10 mm long; pedicel 2–6 cm long, 2–3 mm diameter, articulation at the peduncle, glabrous; calyx lobes free in bud, lobes broadly triangular *c.* 8 × 8 mm, chartaceous, fimbriate; petals 25–30 × 15–20 mm, elliptic; stamens in 4 whorls, staminal tube *c.* 2 mm high; disk a thin (fleshy, triangular) ring, *c.* 1.5 mm high; ovary 4-loculed, style *c.* 30 mm long, ovules 11–13 per locule, septa incomplete. **Fruits** oblong to musiform, 11–14 × 2.8–3.5 cm, apex truncate, base narrowly tapering; pericarp *c.* 3 mm thick, fissured; mesocarp with many small fibers. **Seeds** 6, arranged one above another in a crooked or *zig-zag* column, irregularly shaped, ovoid with concavities where other seeds fit closely together, 2.5–3.5 × 1.8–2.4 cm.

Distribution. Endemic to Borneo. Known from Sarawak (Rejang, Kapit, and Kuching; e.g., *Haviland 2936*, *S 18245* and *S 40236*) and Kalimantan (e.g., *Hallier 3067*).

Ecology. Inland riverine and mixed dipterocarp forests, at altitudes to 900 m.

Notes. This species is very unusual for *Barringtonia* in that it possesses many ovules (more than 30) per ovary, and has more than one seed in each fruit. It is reminiscent of species of *Abdulmajidia* Whitmore, a genus within the family described by Whitmore (Kew Bull. 29 (1974) 207) from Peninsular Malaysia, in seed number and position of the ovules in the locules. However, the species has 4-locular ovary and a long, pendulous inflorescence, typical for *Barringtonia* species. Further work is needed to explore the relationship between this species and those of *Abdulmajidia*.

8. **Barringtonia havilandii** Ridl.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Kew Bull. (1938) 284; Knuth *l.c.* 34; Masamune *l.c.* 513; Payens *l.c.* 242; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 158. **Type:** *Haviland 2935*, Borneo, Sarawak (holotype SING; isotypes K, SAR). **Synonym:** *B. baramensis* Knuth *l.c.* 33.

Tree. **Twigs** *slender*, *4–9 mm diameter*, *not flaky* or *ridged*. **Leaves** tufted at ends of twigs, *chartaceous*, glabrous; elliptic, obovate-oblong, rarely obovate-lanceolate, 24–37 × 8–11 cm, base cuneate, attenuate or decurrent, *margin serrate-crenulate*; apex acuminate; *lateral veins 16–25*(*–32*) *pairs*; *petiole 1–8.5*(*–11.5*) *cm long*, 2.5–4.5 mm diameter at base. *Cataphylls* triangular, *c.* 23 × 6 mm, *caducous*. **Inflorescences** *racemose*, terminal or lateral, pendulous, rachis initially hairy, soon becoming glabrous, 40–110 cm long, 1.5–3 mm diameter at base, slightly fissured, covered with powdery granules; bracts triangular, *c.* 3.5 × 0.5 mm. **Flowers:** *buds c.* 8 mm long, *not mucronate*; *hypanthium tubular*, *often extending into a pseudopedicel*, trigonous or subtetragonous, 3–7 mm long, covered with powdery granules; pedicel thin, 5–20 mm long; *calyx lobes* 3–4, *free in bud*, semicircular, 3–6 × 3–5 mm; petals 9–14 × 6–10 mm, elliptic, convex; stamens in 3–4 whorls, staminal tube 1–3 mm high; disk thin, 0.5–0.8 mm high; ovary 3(–4)-loculed, style *c.* 2–3 cm long, ovules 2–5 per locule. **Fruits** unknown.

Distribution. Endemic to Borneo. Known from Sarawak (Kuching and Kapit districts; e.g., *Haviland 2935* and *Haviland 2937*), Brunei (e.g., *Johns 7441*) and Kalimantan.

Ecology. In inland riverine forest.

9. **Barringtonia lanceolata** (Ridl.) Payens Fig. 1.

(Latin, *lanceolatus* = broadest at the middle, tapering to each end; referring to the leaf)

Blumea 15 (1967) 250; Anderson *l.c.* 231; Cockburn *l.c.* 47; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 333; Beaman *et al. l.c.* 419. **Basionym:** *Careya lanceolata* Ridl. *l.c.* (1938) 285. **Type:** *Haviland 2933*, Borneo, Sarawak (holotype K; isotype SAR). **Synonyms:** *Planchonia lanceolata* (Ridl.) Knuth *l.c.* 54; *B. pseudoglomerata* P.Chantaranothai, Kew Bull. 50 (1995) 697. Type: *Othman*, *Jugah & Anyie S 31858*, Borneo, Sarawak, Ulu Sg. Tutoh (holotype L; isotypes A, K, SAN, SAR, SING), ***syn. nov.***

Tree, 8–30 m tall, 10–33(–60) cm diameter, with short buttresses. **Bark** smooth, dippled or slightly flaky, hard, brown, grey or reddish brown with grey patches; inner bark brown or pink. **Sapwood** yellow or white. **Twigs** *slender*, *1.5–5 mm diameter*. **Leaves** *chartaceous*, glabrous, often distinctly grey above when dry, yellow-ochre below; obovate-oblong to oblong, 9–17(–25) × 3–7(–9) cm, margin entire or serrate-crenulate, apex acute or acuminate, rarely emarginate; *lateral veins 8–11 pairs*; *petiole* (*1–*)*3–5*(*–8*) *cm long*, 1–2 mm diameter. **Inflorescences** *spicate*, *erect*, borne on leafless older twigs; rachis 5–25(–100) cm long, 5–8 mm diameter at base, glabrous; bracts lanceolate, 3–7 mm × 1–3 mm, apex rounded. **Flowers:** buds *c.* 10 mm diameter; hypanthium subtetragonous, 5–12 × 4–9 mm, glabrous; calyx lobes free in bud, suborbicular, 3–6 × 5–9 mm; petals 4, 23–30 × 10–16 mm, elliptic, convex; stamens in 4(–5) whorls, staminal tube 3–4 mm; disk 0.5–1 mm high; ovary 4-loculed, style 45–50(–60) mm long, ovules 3–6 per locule. **Fruits** ovoid or fusiform, (6–)6.5–8.5(–10.5) × (2.5–)3–5(–7) cm, apex truncate, base tapering; pericarp 6–15 mm thick; mesocarp with thick anastomosing fibers. **Seeds** ovoid or spindle-shaped, 5 ribbed, 3–4.5 cm long.

Vernacular names. Brunei—*jempalang*, *jempalang apoi* (Dusun), *langkong* (Iban), *putat* (Malay).

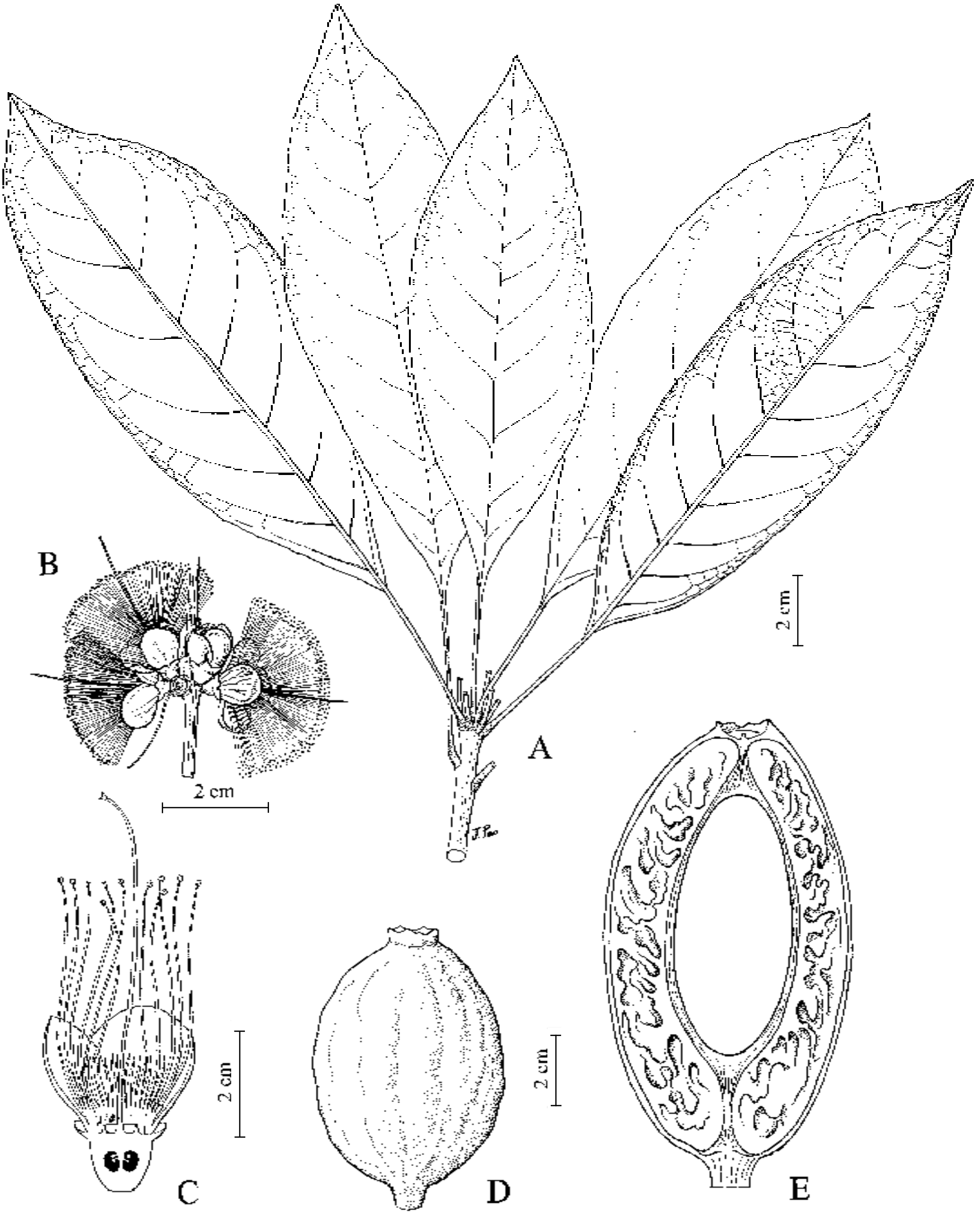

Fig. 1. *Barringtonia lanceolata*. A, leafy twig; B, part of inflorescence showing two fully open flowers; C, longitudinal section of flowers; D, fruit; E, longitudinal section of a mature fruit showing woody pericarp and a single solid seed/embryo at the centre. (A–C from *SAN 17288*, D from *SAN 94948*, E from *SAN 116597*.)

Distribution. Endemic to Borneo. Known from Sabah (Keningau, Lahad Datu, Sandakan, and Tawau districts; e.g., *SAN 15381*, *SAN 24437*, *SAN 49146*, *SAN 73757*, and *SAN 120958*), Sarawak (Miri, Marudi, Kuching, Serian, and Bintulu districts; e.g., *S 13309*, *S 18193*, *S 33594*, *S 33728*, and *S 34348*), Brunei (e.g., *BRUN 255*, *Dransfield JD 6679* and *Wong WKM 1405*), and Kalimantan (e.g., *Kostermans 21695*).

Ecology. In lowland and hill mixed dipterocarp to lower montane forests, at altitudes to 1700 m.

Uses. In Sabah, the bark is sometimes used as a fish poison.

10. **Barringtonia longisepala** Payens

(Latin, *longus* = long, *sepalum* = sepal; in reference to the extended hypanthium)

Blumea 15 (1967) 191; Anderson *l.c.* 231; Cockburn *l.c.* 46; Whitmore, Tantra & Sutisna *l.c.* 192. **Type:** *Sam SAN 26364*, Borneo, Sabah, Sandakan (holotype L; isotypes K, SAN).

Tree to 21 m tall, 35 cm diameter. **Bark** fissured, dark grey or greyish brown, with distinct lenticels. **Sapwood** white. **Twigs** *slender*, *4–8 mm diameter*. **Leaves** *coriaceous*, glabrous, glossy above; *oblong* to *obovate-lanceolate*, (10–)15–20(–23) × (3–)4–7(–8) cm, base cuneate to decurrent, margin entire, apex acuminate, acute or rounded; *lateral veins* (*9*)*11–15*(*–18*) *pairs*, prominent on both sides; *petiole 2–5 cm long*, *not winged* or *rugose*. Cataphylls *c.* 6 × 1.5 mm. **Inflorescences** *racemose*, terminal, rachis 25–86 cm long, 3–4 mm diameter at base, increasing to 6–8 mm, yellowish puberulous, slightly fissured; bracts lanceolate, 5–11 × 1–3 mm. **Flowers:** buds 12–20 mm long; hypanthium tetragonous, tubular, 7–10 mm long, puberulous, extending into a stout pedicel of 5–15 mm long, 2–4 mm diameter, puberulous; calyx lobes connate in bud, sometimes with apical pore when young, rupturing into 3–4 equal segments, 10–18 × 10–20 mm increasing to 25–33 × 10–20 mm; petals 4, 35–45 × 20–25 mm, obovate to elliptic, convex; stamens in 6(–7) whorls, staminal tube 2–3 mm; disk 1–1.5 mm high; ovary 4-loculed, style 40–55 mm long, increasing to 65 mm, ovules 3–5 per locule. **Fruits** oblong, 13–14 × 5–5.5 cm, slightly tetragonous; pericarp 5–11 mm thick; exocarp rugose; mesocarp spongy with dispersed large and small fibres. **Seeds** ovoid, deeply fissured, *c.* 7 cm long.

Vernacular name. Sabah—*tampalang* (Dusun).

Distribution. Endemic to Borneo. Known from Sabah (Beaufort, Sandakan, and Sipitang districts; e.g., *SAN 26364* and *SAN 41781*), Sarawak (Miri district; e.g., *S 37001*) and Brunei (e.g., *S 5558*).

Ecology. In primary and secondary inland forests on sandstone hills; also recorded in mixed peatswamp forest.

11. **Barringtonia macrocarpa** Hassk.

(Greek, *makro* = large, *karpon* = fruit; relating to the large fruit)

Flora 25, 2 (1842) Beibl. 36; Payens *l.c.* 237; Whitmore *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288. **Type** (Payens, 1967)**:** *Description by Hasskarl*. **Synonyms:** *Megadendron macrocarpum*

(Hassk.) Miers *l.c.* 109, *t.* 15; *Michelia macrocarpa* (Hassk.) Kuntze *l.c.* 241; *Stravadium insigne* Blume *in* Van Houtte, Fl. Serr. 7 (1851) 21, 24, *t.* 654; *B. insignis* Miq., Fl. Ind. Bat. 1, 1 (1855) 488, Backer & Bakhuizen *f. l.c.* 353; *Michelia insignis* (Miq.) Kuntze *l.c.* 240; *B. acutangula auct. non* (L.) Gaertn.: Blume *l.c.* (1826) 1097. (For complete synonymy see Payens *l.c.* 237).

Shrub or small to medium-sized tree, 1.5–13(–30) m tall, 5–16(–24) cm diameter. **Twigs** *stout*, (*5–*)*7–15 mm diameter*, *not winged*. **Leaves** *in two or more whorls at ends of twigs*, subcoriaceous to chartaceous, glabrous; *obovate-lanceolate* or *linear-lanceolate*, 29–60(–70) × 4–6.5(–18) cm, base narrowly cuneate to decurrent, *margin finely serrate-crenulate*, especially towards apex, apex acuminate, cuspidate or obtuse; *lateral veins* (*16–*)*22–34 pairs*; *petiole 1.5–2 cm long*. **Inflorescences** racemose, terminal, pendulous, *rachis* (26–) 40–75(–112) cm long, 2–7 mm diameter at base, *glabrous*, *not winged*; bracts, densely tufted at the base of peduncle, lanceolate-triangular, 5–75 × 2–30 mm. **Flowers:** buds 5–12 mm long; hypanthium, 3–4-gonous or globular (vase-shaped), 7–11 mm long, glabrous, extending into pedicel of 15–30 mm long, glabrous, articulation at penduncle; calyx lobes free in bud, unequal, broadly ovate, 3–5 × 3–5 mm, persistent; petals 17–28 × 7–15 mm, elliptic, obtuse, convex; stamens in 3–4 whorls, staminal tube 0.5–5 mm high; disk a grooved small ring, to 1 mm high; ovary 3-loculed, style 35–42 mm long, ovules 2–5 per locule. **Fruits** 3–4-gonous, 6–12.5 × 1–3 cm, 3–4-winged, narrowly tapering towards base, apex truncate, glabrous; pericarp *c.* 2.5 mm thick. **Seeds** ovoid, fissured.

Distribution. Vietnam, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, known from Sabah (e.g., *Keith FD. F.M.S. 44691* and *SAN 48814*), Sarawak (Bt. Raya, Pelagus; e.g., *S 17768*) and Kalimantan.

Ecology. Inland riverine and swamp forests, at low elevations.

12. **Barringtonia macrostachya** (Jack) Kurz

(Greek, *makro* = large, long, great, *stachys* = spike; referring to the inflorescence)

Rep. Pegu (1875) App. A, lxvi, App. B 52 *in clavi*; Merrill *l.c.* (1921) 419; Burkill *l.c.* 305; Payens *l.c.* 244; Whitmore *l.c.* 260.; Anderson *l.c.* 231; Cockburn *l.c.* 46; Corner *l.c.* 392; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Careya macrostachya* Jack, Mal. Misc. 1 (1821) 47. **Type** (Payens, 1967)**:** *Jack's description*. **Synonyms:** *Doxomma macrostachyum* (Jack) Miers *l.c.* 104; *Michelia macrostachya* (Jack) Kuntze *l.c.* 241; *Doxomma sumatrana auct. non* (Miq.) Miers: Miers *l.c.* 103; *B. sumatrana auct. non* Miq.: Ridley *l.c.* (1922) 758, Burkill *l.c.* 307.

Shrub or small to medium-sized tree, 4–20(–30) m tall, 3–35(–95) cm diameter. **Bark** smooth or scaly, brown, greenish yellow or greyish brown or brown with grey mottling; inner bark thin, soft, fibrous. **Sapwood** pale yellow. **Twigs** *slender*, *5–10 mm diameter*. **Leaves** *chartaceous*, glabrous; obovate-oblong to oblong, (10–)15–25(–45) × (4–)6–8(–10) cm, *margin shallowly serrate-crenulate*, *not revolute*, apex cuspidate or caudate; *lateral veins* (*10–*)*14–18*(*–21*) *pairs*; *petiole 2.5–10*(*–17*) *cm long*, thick at base. Cataphylls triangular, 4.5–7 × 1–2 mm, glabrous. **Inflorescences** *spicate*, terminal or borne on leafless older twigs, *pendulous*, *rachis* (10–)19–45(–75) cm long, *3–6 mm diameter at base*, *increasing to 10 mm*, *glabrous*; bracts triangular, lanceolate, 5–11 × 1.5–3 mm. **Flowers:** buds 7–9 × 7–9 mm; *hypanthium tetragonous*, *hard*, *4–6 mm long*, *glabrous*; calyx lobes free in bud, suborbicular, glabrous, convex, chartaceous, 3–5 × 4–6 mm; petals 4, 20–23 × 15 mm, elliptic to suborbicular; stamens in 4(–5) whorls, staminal tube 1.5–3 mm high; disk thin, grooved, 0.5–1.5 mm high; ovary 4-loculed, style 40–45 mm long, ovules 2–4 per locule. **Fruits** obovoid, 5.5–9 × 2–4 cm, tetragonous, apex truncate, base emarginate; pericarp 3–10 mm thick. **Seeds** ovoid, 3–4.5 cm long.

Vernacular names. Sabah—*tampalang* (Dusun Kinabatangan). Sarawak—*karuk* (Iban).

Distribution. China (S Yunnan), Vietnam, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, N Sulawesi, Maluku, and several other islands in the region. In Borneo, known from Sabah (all districts; e.g., *SAN 26291*, *SAN 53601*, *SAN 67305*, *SAN 80657*, and *SAN 122817*), Sarawak (e.g., *S 33806*, *S 42026* and *S 46748*), Brunei, and Kalimantan.

Ecology. In hill mixed dipterocarp forest along rivers or in swampy areas, on sandy or loamy soils, at altitudes to 1300 m. The fruits are presumably dispersed by animals (primarily small rodents).

Uses. Pulped root is used in the treatment of ringworm and sore eyes. Leaves are also used medicinally in the treatment for stomach aches. Bark is used as a fish poison.

13. **Barringtonia pendula** (Griff.) Kurz

(Latin, *pendulus* = dangling; referring to the inflorescence)

J. As. Soc. Beng. 46, 2 (1877) 71; Payens *l.c.* 248; Whitmore *l.c.* 261; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Kessler & Sidiyasa *l.c.* 160; Turner *l.c.* 288; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Careya pendula* Griff. *l.c.* 661. **Type:** *Griffith s.n.*, Myanmar, Mergui (isotype W, *n.v.*). **Synonyms:** *Doxomma pendula* (Griff.) Miers *l.c.* 99; *B. musiformis* King *l.c.* 139, Ridley *l.c.* (1922) 758, Knuth *l.c.* 30, Corner *l.c.* 355. (For complete synonymy see Payens *l.c.* 248).

Tree, 15–33(–47) m tall, 20–80(–90) cm diameter; bole slightly ribbed at base. **Bark** reddish brown, mottled with vertical cracks and thin flakes; inner bark fibrous. **Sapwood** light brown. **Twigs** *slender*, *3–10 mm diameter*. **Leaves** *subcoriaceous* to *chartaceous*, sometimes glaucous beneath; obovate-lanceolate or obovate-oblong, (11–)16–25(–36) × (4–)5–7(–9) cm, base long-cuneate, *margin entire* or *serrate-crenulate towards apex*, *often revolute*, apex acuminate; *lateral veins 8–15(–18) pairs*, prominent beneath but not above; *petiole (1.5–) 3–4(–6) cm long*. **Inflorescences** *spicate*, *borne on leafless older twigs*, *pendulous*; *rachis* (2–)3.2–4.1(–11) cm long, *5–6 mm diameter at base*, *increasing to 15 mm*, fissured, *glabrous* or *covered with powdery granules*; bracts triangular *c.* 7 × 4 mm. **Flowers:** buds 10–20 mm long; *hypanthium* 6–12 mm long, *subterete* or *tetragonous*, with *4 distinct grooves* or *ribs on the corners*, *6–12 × 5–8 mm*, *reddish brown pubescent*; calyx lobes free in bud, suborbicular, 12–18 mm, chartaceous, slightly reddish brown pubescent; petals 20–38 × 15–18 mm, elliptic-rounded, fimbriate; stamens in 4(–6) whorls, staminal tube 3–8 mm high; disk 1.5–2 mm high; ovary (3–)4-loculed, style 45–60 mm long, ovules 3–6 per locule. **Fruits** ovoid or musiform (banana-shaped), (6–)8–12.5(–15) × (1.5–)2–3.5 cm, covered with powdery granules, fissured and warty, very hard, apex and base truncate; pericarp 4–6 mm thick; mesocarp hard, filled with fine fibers. **Seeds** unknown.

Vernacular name. Sarawak—*langkong* (Iban).

Distribution. China, Myanmar, Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (Kinabatangan, Pensiangan, and Tawau districts; e.g., *SAN 31093*, *SAN 31362*, *SAN 133554*, and *SAN 37136*), Sarawak (Kuching and Ulu Sinrok; e.g., *S 14615*, *S 15646* and *S 18113*) and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 1200 m.

14. **Barringtonia pterita** Merr.

(Greek, *pteron* = wing; referring to the winged fruit)

Philip. J. Sci. Bot. 9 (1914) 322; Payens *l.c.* 210. **Type:** *Ramos BS 15121*, the Philippines, Luzon (isotypes K, US).

Tree or shrub, 7–10 m tall, 10–12 cm diameter. **Bark** black. **Sapwood** pale yellow. **Twigs** *slender*, *5–8*(*–10*) *mm diameter*, *not flaky* or *ridged*. **Leaves** *chartaceous*, glabrous; obovate-lanceolate or linear-lanceolate, rarely obovate-oblong, (13–)17–40(–52) × 3–9 cm, *base cuneate*, *margin serrate-crenulate* towards apex, apex cuspidate or acuminate; *lateral veins* (*15–*)*20–25*(*–28*) *pairs*; *petiole 0.5–1 cm long*. *Cataphylls caducous.* **Inflorescences** *racemose* or *spicate*, *pendulous*, terminal or borne on leafless older twigs; *rachis* 58–71(–144) cm long, *2–3 mm diameter at base*, accrescent to *c.* 5 mm, *glabrous*, slightly fissured; bracts triangular, 2.5–5 × 1–2 mm, serrate. **Flowers:** *buds c. 10 mm long*; *hypanthium tetragonous*, *sharply angled* or *winged*, *c.* 5 × 3–5 mm, glabrous or covered with powdery granules; pedicel to 12 mm long, often tetragonous or winged apically; *calyx lobes connate in bud*, disrupting into 2(–3) unequal segments, lobes convex, 9–10 × 6–11 mm, chartaceous; petals 15–20 × 7–10 mm, elliptic, convex; stamens in 3 whorls, staminal tube 1.5–3 mm high; disk small ring, *c.* 0.5 mm high; ovary (3–)4-loculed, tetragonous, style *c.* 35 mm long, ovules 3–5 per locule. **Fruits** 4–6 × 1–2.5 cm, distinctly winged, tetragonous, glabrous, apex truncate, tapering towards base, wings 4–7 mm wide; pericarp *c.* 3 mm thick. **Seeds** ovoid, deeply fissured, 2.5–3.5 cm long.

Distribution. Borneo and the Philippines. In Borneo, occurs only in Sabah (Kinabatangan and Sandakan districts; e.g., *SAN 22629*, *SAN 46186*, *SAN 90808*, and *SAN 117965*).

Ecology. On banks of rivers and creeks, on ridges, and in swamp forest, from sea level to 170 m altitude.

15. **Barringtonia racemosa** (L.) Spreng. Fig. 2.

(Latin, *racemosus* = raceme-like; the inflorescence)

Syst. Veg. 3 (1826) 127; Merrill *l.c.* (1921) 419; Ridley *l.c.* (1922) 757; Burkill *l.c.* 305; Payens *l.c.* 192; Whitmore *l.c.* 259; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Eugenia racemosa* L. *l.c.* (1753) 471. **Syntypes:** *Herb. Hermann 212*, *213* and *339* (all at BM). **Synonyms:** *Stravadium racemosum* (L.) Sweet, Hort. Brit. edition 1 (1826) 159; *B. elongata* Korth., Ned. Kruidk. Arch. 1 (1846) 206; *B. timorensis* Blume *l.c.* (1851) 23; *Butonica racemosa* (L.) Miers *l.c.* 66; *Michelia racemosa* (L.) Kuntze *l.c.* 240; *M. timorensis* (Blume) Miers *l.c.* 241; *Huttum racemosum* (L.) Britten *l.c.* 67.

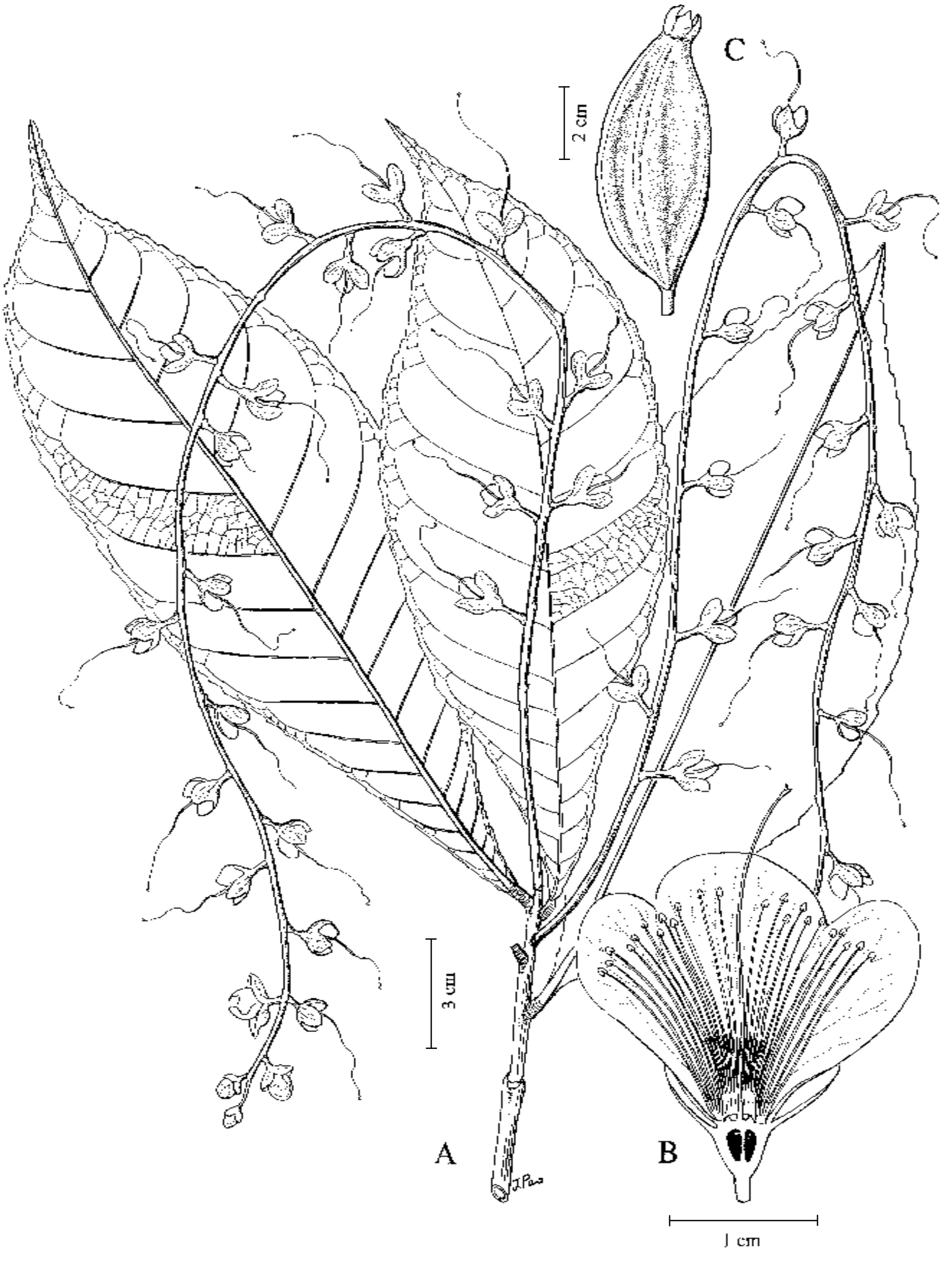

Fig. 2. *Barringtonia racemosa*. A, flowering leafy twig; B, longitudinal section of fully open flower; C, immature fruit. (A–B from *SAN 80585*, C from *SAN 126092*.)

Shrub to medium-sized tree, 2–20(–27) m tall, 10–50 cm diameter; bole erect or crooked, occasionally many-stemmed, swollen at base; buttresses with surface roots. **Bark** yellowish grey, smooth or fissured. **Sapwood** white, soft. **Twigs** *slender*, *3–6 mm diameter*, *not obviously flaky* or *ridged*. **Leaves** *chartaceous*, glabrous; obovate-oblong or obovate-lanceolate, 14–36(–42) × 4–14(–16) cm, *base cuneate*, *margin serrate-crenulate*, *apex acute* or *acuminate*; *lateral veins* (*10–*)*13–18*(*–20*) *pairs*, more prominent beneath than above; *petiole 0.2–1*(*–1.5*) *cm long*, 2.5–4 mm diameter, slightly winged. *Cataphylls* triangular, 5–11 × 2–8 mm, *caducous*. **Inflorescences** *racemose* or *spicate*, *pendulous*, mostly terminal, sometimes borne on leafless older twigs; *rachis* 20–70(–100) cm long, *2–3 mm diameter*, glabrous or puberulent; bracts triangular, 5–6 × 1.5–2 mm. **Flowers:** *buds* 6–9 × *6–10 mm at base*, *often mucronate*; *hypanthium* (4–)6–12 mm long, *funnel-shaped*, *without angles or wings*, *often extending into a pseudopedicel of 2–20 mm long*, covered with powdery granules or glabrous; *calyx lobes connate in bud*, rupturing into 2–4(–5) equal or unequal elliptic lobes, 7–15 × 5–13 mm; petals 4, 15–25 × 5–15 mm, elliptic obtuse, convex; stamens in (5–)6 whorls, staminal tube 3.5–6 mm high; disk thick, grooved; ovary (2–)3–4-loculed, style (2–)3–5.5 cm long; ovules 2–3 per locule. **Fruits** *ovoid*, 5–7(–9) × 2–4(–5.5) cm, *subtetragonous*, *slightly winged when young*, apex truncate, tapering at base; pericarp 3–12 mm thick, fleshy; exocarp with dispersed fibers. **Seeds** ovoid, 2–4 cm long, subtetragonous, tapering towards apex, flat at base.

Vernacular names. Sabah—*putat ayer*, *putat sungai* (Kadazan), *utak-utak* (Tidong). Sarawak—*putat rambai* (Malay).

Distribution. E and S Africa, Madagascar, the Seychelles Islands, India, Sri Lanka, Myanmar, Thailand, throughout SE Asia and the Pacific Islands to N Australia. In Borneo, known from Sabah (Beaufort, Kudat, Sandakan, and Sipitang districts; e.g., *SAN 80585*, *SAN 102919*, *SAN 103275*, *SAN 126092*, and *SAN 126937*), Sarawak (Kuching district; e.g., *S 41871*), Brunei (e.g., *van Niel 4163* and *van Niel 4190*), and Kalimantan.

Ecology. In forests on tidal riverbanks just beyond saline influence.

Uses. The wood of this species is used for fuel and construction in some areas, though it is rarely used in Borneo. Leaves or leaves mixed with bark or roots, are used medicinally as a poultice for itching skin and chicken pox. Seeds are also used as a poultice for ophthalmia and taken internally for colic. Bark is used as a tanning agent.

16. **Barringtonia reticulata** (Blume) Miq.

(Latin, *reticulatus* = like a network; in reference to the leaf venation)

Fl. Ind. Bat. 1, 1 (1855) 490; Merrill *l.c.* (1921) 419; Masamune *l.c.* 514; Payens *l.c.* 252; Anderson *l.c.* 231; Corner *l.c.* 392; Whitmore *l.c.* 260; Whitmore, Tantra & Sustisna *l.c.* 192; Kessler & Sidiyasa *l.c.* 159; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Stravadium reticulatum* Blume *l.c.* (1851) 24. **Type:** *Korthals s.n.* (= *RHL Sheet Nos. 898204205–898204207*), Borneo, Kalimantan (holotype L; isotype U). **Synonyms:** *B. sumatrana* Miq., Fl. Ind. Bat. Suppl. (1862) 315; *B. gitingensis* Elmer,Leafl. Philip. Bot. 8 (1915) 2730.

Shrub or small tree, 2–10 m tall, 3–20 cm diameter, with drooping or straggling branches. **Bark** deeply fissured, roughly cracked, grey. **Twigs** *slender*, *c. 4 mm diameter*. **Leaves** *coriaceous*, glabrous, *drying concolourous*; elliptic, (11–)14–18(–22) × (3–)5–7(–8) cm, base decurrent, margin entire to slightly serrate-crenulate and revolute, apex acute or obtuse; *lateral veins 9–18 pairs*; *petiole* winged, *2.5–6 cm long*, 2–3 mm diameter. Cataphylls triangular, 3–6 × 1–2.5 mm. **Inflorescences** *spicate*, *terminal*, pendulous; rachis 30–65 cm long, 2 mm diameter at base, slightly fissured, glabrous; bracts triangular, *c.* 5 × 1 mm. **Flowers:** buds 8–10 × 4 mm; hypanthium funnel-shaped, tetragonous with acute edges, 4–6 × 4–5 mm, glabrous; calyx lobes free in bud, equal, convex, coriaceous, suborbicular, 4.5–6 × 4–6 mm, persistent; petals 17–20 × 6–9 mm, elliptic, obtuse, convex; stamens in 4 whorls, staminal tube 2–3 mm high; disk annular, *c.* 0.5 mm high; ovary 4-loculed, style 40–60 cm long; ovules 2–4 per locule. **Fruits** tetragonous, 3.5–5 × 1–2 cm, sharply 4-angled with the sides depressed at base, truncate at apex and base; pericarp mostly shiny, 1–2 mm thick on sides, 4–5 mm thick on corners. **Seeds** ovoid, trigonous, *c.* 2 cm long, deeply fissured, tapering at both ends.

Vernacular name. Sarawak—*putat paya* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, and SE Sulawesi. In Borneo, occurs in Sarawak (Kuching and Bintulu districts; e.g., *S 12051*, *S 14481* and *S 17100*) and Brunei (e.g., *van Niel 3937* and *S 2225*).

Ecology. In *kerangas* forest.

17. **Barringtonia revoluta** Merr.

(Latin, *revolutus* = rolled back from edge; referring to the leaf margin)

Philip. J. Sci. 1 (1906) Suppl. 211; Knuth *l.c.* 36; Payens *l.c.* 199; Anderson *l.c.* 231; Cockburn *l.c.* 46; Whitmore *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159. **Type:** *Curran 3507*, the Philippines, Palawan (holotype PNH†; isotypes K, L). **Synonym**: *B. flagellata* Liitjeh. & Ooststr., Blumea 3 (1938) 95.

Tree 5–20(–33) m tall, 25–50 cm diameter; bole sometimes crooked or sprawling. **Bark** pale brown, crumbling, rough or smooth, mottled with green and brown; inner bark hard, redbrown to cream coloured. **Sapwood** hard, yellow. **Twigs** *slender*, *3–7 mm diameter*. **Leaves** *subcoriaceous*, glabrous; obovate-lanceolate, 11–22(–34) × 3–6(–13) cm, margin serrate-crenulate and distinctly revolute; *lateral veins 14–16 pairs*, prominent beneath; intercostal venation equally distinct on both sides; *petiole 1–9(–11) cm long*, *rugose*, *thick*, *slightly winged*. Cataphylls caducous. **Inflorescences** *racemose*, terminal or borne on leafless older twigs, pendulous; rachis 70–80 cm long, 1–2 mm diameter at base, glabrous; bracts triangular, *c.* 1 × 0.5 mm. **Flowers:** buds 5–10 × 5–10 mm; hypanthium trigonous, obpyramidal with acute edges, 3–5 × 2.5–4 mm, glabrous; pedicel 5–20 mm long, very thin; calyx lobes connate in bud, rupturing into (2–)3(–4) segments, convex, elliptic or suborbicular, 9–12 × 6–10 mm, persistent and slightly accresent, chartaceous; petals 17–20 × 10–13 mm, elliptic, obtuse, convex; stamens in 4 whorls, staminal tube *c.* 1.5 mm high; disk thin, outside grooved, 0.25–0.5 mm high; ovary 3(–4)-loculed, style 35–45 mm long; ovules (2–)3–4 per locule. **Fruits** sharply 3–4-gonous, 4.5–6 × 1.2–1.8 cm, apex truncate, base cuneate, distinctly pedicelled, sides depressed towards base; pericarp thin, *c.* 0.5–1 mm thick at sides. **Seeds** ovoid, trigonous, *c.* 3 cm long.

Vernacular names. Sarawak—*karut* (Iban). Brunei—*putat samba* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Palawan). In Borneo, occurs in Sabah (Beaufort and Papar districts; e.g., *SAN 80630*, *SAN 102973*, *SAN 111453*, *SAN 115559* and *SAN 127098*), Sarawak (e.g., *S 4936*) and Brunei (e.g., *BRUN 929*, *BRUN 5162*, *Sands 5633*, and *Wong WKM 2051*).

Ecology. In primary lowland mixed dipterocarp forest on sandy-clay soils, seasonal swamp forest on riverbanks, and *kerangas* forest, at altitudes to 200 m.

18. **Barringtonia sarawakensis** P.Chantaranothai

(of Sarawak)

Kew Bull. 50 (1995) 700. **Type:** *Soepadmo & Chai S 28183*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype L; isotypes A, BO, K, SAN, SAR, SING).

Tree, 10–30 m tall, to 30 cm diameter; bole slightly fluted below. **Bark** light chocolate brown to reddish brown, flaky and slightly pock-marked, thin. **Sapwood** yellow. **Twigs** *slender*, *2–4 mm diameter*, *not obviously flaky* or *ridged*. **Leaves** *subcoriaceous* to *chartaceous*, *glabrous*; *elliptic*, *narrow elliptic* to *obovate*, *6–13 × 3.5–5 cm*, base cuneate to slightly decurrent, *margin entire*, sometimes revolute, apex acuminate to cuspidate or emarginate or acute; *lateral veins 7–12 pairs*, prominent beneath; *petiole 0.6–1.2 cm long*, *not winged* or *rugose*. *Cataphylls caducous*. **Inflorescences** *racemose*, terminal or axillary; rachis 1.5–4 cm long, up to 2 mm diameter at base, glabrous, few-flowered; bracts caducous. **Flowers:** buds to 5 mm diameter; hypanthium funnel-shaped, *c.* 10 mm long, extending into narrow pedicel of 30–50 mm long, *c.* 1 mm diameter at base, articulation at point of attachment to rachis; calyx lobes connate in bud, mucronate, rupturing into 2–3 persistent lobes, 12–14 × 9–11 mm, oblong-lanceolate; petals *c.* 6 × 8 mm, ovate, rimmed with ciliate teeth; ovary 2-loculed, style 40–45 mm long; ovules 4–7 per locule. **Immature fruits** green, ovoid-oblong, 3–4 × 2 cm, sharply tapering towards base, apex truncate; pericarp *c.* 2 mm thick.

Vernacular names. Sarawak—*karut putat* (Iban), *pelenuim* (Kenyah).

Distribution. Endemic to Borneo and confined to Sarawak (Kuching, Bintulu, Kapit, and Baram districts; e.g., *S 28183*, *S 34827*, *S 36808*, *S 43412*, and *S 44507*).

Ecology. Hill mixed dipterocarp forests, at altitudes to 1000 m.

Notes. Morphologically, the species is very similar to *B. filirachis* Payens but is found in an entirely different habitat from the swampy lowland forest where *B. filirachis* is found in Johore, Peninsular Malaysia. The spirally arranged leaves along the branches, decurrent leaf base, terminal few-flowered racemose inflorescences, and 4–7 ovules per locule inserted along the central axile strongly suggest that the species may belong to *Planchonia* (Editors).

19. **Barringtonia sarcostachys** (Blume) Miq. Fig. 3.

(Greek, *sarco* = fleshy, *stachys* = relating to spike; referring to the fleshy inflorescence rachis)

Fl. Ind. Bat. 1, 1 (1855) 490; Knuth *l.c.* 34; Payens *l.c.* 216; Cockburn *l.c.* 47; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Coode *et al.* (eds.) *l.c.* 159. **Basionym:** *Stravadium sarcostachys* Blume *l.c.* (1851) 24. **Type:** *Praetorius s.n.* (= *RHL Sheet Nos. 898294176–898294181*), Sumatra (holotype L; isotype BO). **Synonyms:** *Doxomma sarcostachys* (Blume) Miers *l.c.* 102; *Barringtonia dolichobotrys* Merr., J. Str. Br. R. As. Soc. 77 (1917) 204, *l.c.* (1921) 419, Knuth *l.c.* 22; *B. dolichophylla* Merr. *l.c.* (1917) *205*; *B. anacardifolia* Ridl. *l.c.* (1938) 284; *B. sarcostachys* (Blume) Miq. forma *dolichophylla* (Merr.) Payens *l.c.* 218.

Small to large tree, 8–40 m tall, 5–50 cm diameter. **Bark** cracked, fissured, brown, reddish brown, grey, greenish brown, or blackish mottled; inner bark pink or white. **Sapwood** yellow or white. **Twigs** *stout*, *8–15 mm diameter*, *not distinctly winged*. **Leaves** subcoriaceous, glabrous; obovate, elliptic, lanceolate, or linear-lanceolate, 2–100 × 4.5–15 cm, base cuneate or decurrent, *margin almost entire*, *revolute*, apex rounded or acuminate; *lateral veins* (*10–*)*14–50 pairs*; *petiole 1–13 cm long*. Cataphylls triangular, 6–14 × 2–5 mm. **Inflorescences** spicate, terminal, pendulous; *rachis* (24–)42–130(–180) cm long, 4 mm diameter at base, accrescent to 10–15 mm, glabrous, shiny brown, woody, *not distinctly winged*; bracts sublanceolate-triangular, 4–11 × 2–4 mm. **Flowers:** buds *c.* 15 mm diameter, hypanthium subtetragonous with rounded edges, *c.* 10 × 7 mm, accrescent, glabrous; calyx lobes connate in bud, rupturing into 2–5 unequal segments, segments convex, suborbicular, 14–18 × 12–16 mm, coriaceous, obtuse or acute; petals coriaceous; stamens in 4–6 whorls, staminal tube 4–5 mm high; disk annular, 1.5–2 mm high; ovary 4-loculed, style 40–75 mm long; ovules 4–6 per locule. **Fruits** ovoid to subglobular, 5–11 × 3.5–7.5 cm, rarely pear-shaped, with truncate base; pericarp 4–10 mm thick; exocarp hard. **Seeds** ovoid-subglobular, 3.5–6.5 cm long, deeply fissured.

Vernacular names. Sabah—*tampalang* (preferred name). Sarawak—*langkong* (Iban), *putat* (Malay), *tubai langkong* (Iban).

Distribution. Sumatra and Borneo. In Borneo, occurs in Sabah (Labuk Sugut, Pensiangan, and Sandakan districts; e.g., *RSNB 2610*, *SAN 23737*, *SAN 29969*, *SAN 82122*, *SAN 100764*, and *SAN 131744*), Sarawak (Kuching, Serian and Nyabau FR; e.g., *S 13040*, *S 15894*, *S 16668*, *S 26996*, and *S 31992*), Brunei (e.g., *S 7842* and *Wong WKM 1121*), and Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 300 m.

Uses. Bark is used as fish poison. The tree is sometimes planted as an ornamental.

Notes. Payens (*l.c.*) recognised two forms, distinguishable only by leaf characters. As flower structure appears identical, the forms are not recognised here.

20. **Barringtonia scortechinii** King

(Reverend Scortechini, 1845–1886, sometime a Roman Catholic missionary and government botanist at Taiping, Perak)

J. As. Soc. Beng. 70, 2 (1901) 138; Ridley *l.c.* (1922) 757; Burkill *l.c.* 306; Knuth *l.c.* 30; Payens *l.c.* 233; Whitmore *l.c.* 260; Corner *l.c.* 393; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.*

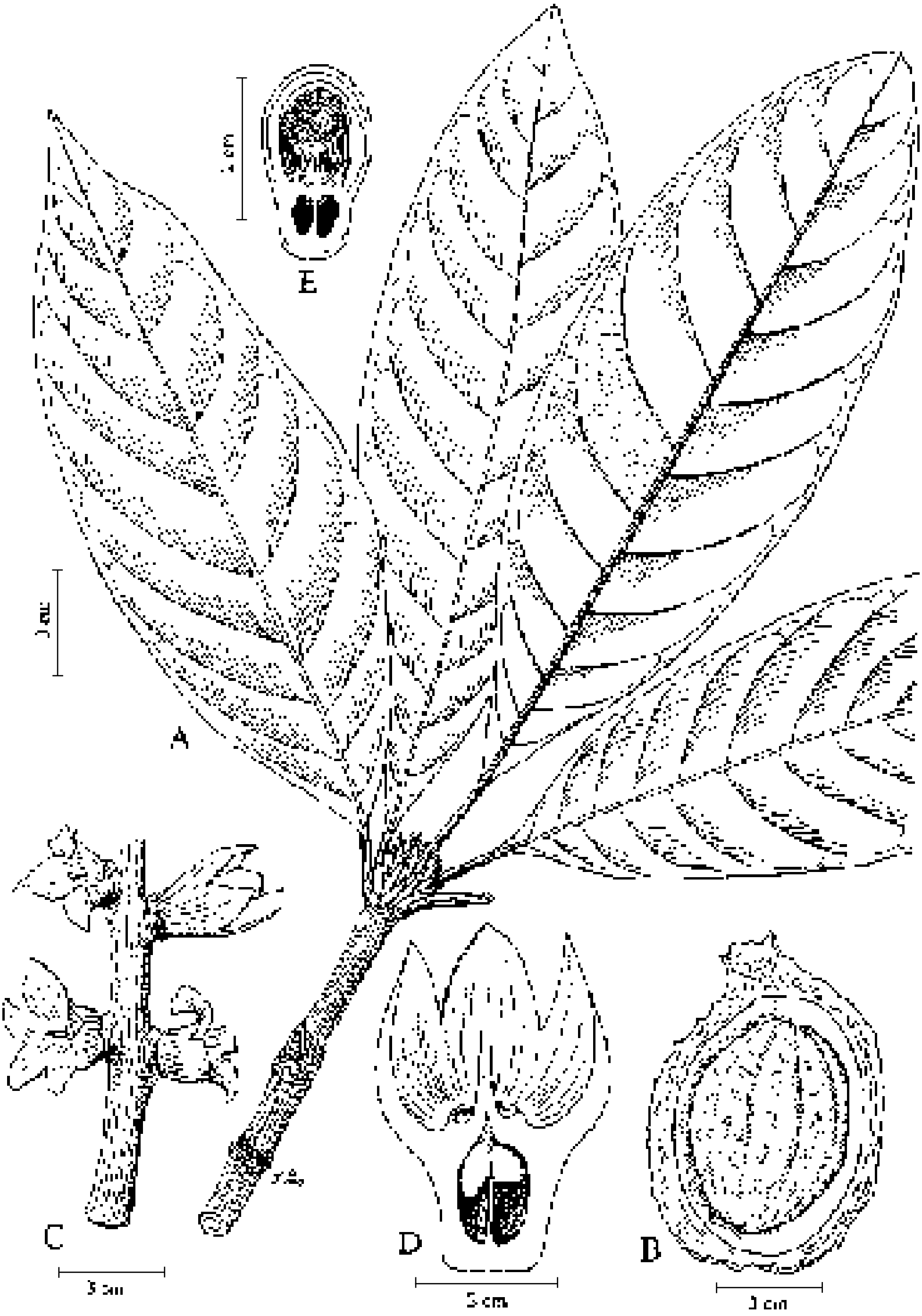

Fig. 3. *Barringtonia sarcostachys*. A, leafy twig; B, longitudinal section of mature fruit; C, portion of young infructescence; D, longitudinal section of young fruit showing two developing ovules/seeds; E, longitudinal section of flower bud. (A–B from *Stevens et al. 419*, C–D from *SAN 108903*, E from *SAN A 3527*.)

288. **Lectotype** (Payens, 1967)**:** *King's Collector 3854*, Peninsular Malaysia, Perak (hololectotype K; isolectotypes BM, P).

Small to large tree, 7–20(–40) m tall, 10–20(–40) cm diameter; buttresses up to 2 m tall; crown round with spreading branches. **Bark** scaly, peeling off in flakes, longitudinally fissured, brown or red; inner bark white or yellow, *c.* 20 mm thick. **Sapwood** yellow. **Twigs** *slender*, *2.5–4 mm diameter*. **Leaves** *subcoriaceous* or *chartaceous*, glabrous; obovate or elliptic, 8–17(–21) × 5–7.5 cm, margin serrate-crenulate, revolute, apex acuminate; *lateral veins 7–10 pairs*, curving upwards rather sharply; *petiole* (*0.5–*)*1.5–5 cm long*, 1–2 mm diameter. **Inflorescences** *spicate*, *mostly borne on leafless older twigs*, rarely terminal, *pendulous*; *rachis* (13–)20–55(–70) cm long, *3–7 mm diameter at base*, accrescent, often fissured, glabrous or slightly pubescent; bracts triangular, *c.* 0.5 × 0.5 mm. **Flowers:** buds 3–5 mm diameter; *hypanthium* tetragonous, *with distinctly winged edges*, often covered with powdery granules, pubescent, 5–9 × 3–6 mm; *calyx lobes free in bud*, thin, convex, 12–18 × 7–10 mm; petals 12–18 × 7–10 mm, elliptic, convex, thin, fimbriate; stamens in 4–5 whorls, staminal tube 3–4 mm high; disk a thick, distinct ring 1–2 mm high; ovary 3–4-loculed, style *c.* 4 cm long; ovules 3–4(–6) per locule. **Fruits** tetragonous with distinct wings on edges which are gradually disappearing as the fruit grows and matures, at maturity ovoid with 8 ridges, 10–12 × 3–5 cm, fissured, rugose, dull, covered with powdery granules; pericarp 4–8 mm thick. **Seeds** ovoid, 5–6 cm long.

Vernacular name. Sabah—*tempalang* (Kadazan).

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, occurs in Sabah (Mt. Kinabalu, Sandakan, and Tawau; e.g., *SAN 16504*, *SAN 24981*, *SAN 31362*, *SAN 61162*, *SAN 75753*, and *SAN 134866*), Sarawak (e.g., *S 52754*), Brunei (e.g., *S 5826*), and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp forests, at altitudes to 1400 m.

Uses. Fruit may be used to add flavour to foods.

2. **PLANCHONIA** Blume

(J.E. Planchon, 1823–1888, a French botanist)

In Van Houtte, Fl. Serr. 7 (1851) 24; King, J. As. Soc. Beng. 70, 2 (1901) 241; Merrill, EB (1921) 143; Ridley, FMP 1 (1922) 759; Backer & Bakhuizen *f.*, FJ 1 (1964) 252; Kuswata, Bull. Bot. Surv. India 7 (1965) 162; Burkill, EPMP 2 (1966) 1796; Whitmore, TFM 2 (1972) 264; Cockburn, TS 2 (1980) 49; Anderson, CLTS (1980) 231; Whitmore, Tantra, & Sutisna, CLK 2, 1 (1990) 193; Ng, MFFSS (1991) 417; Kessler & Sidiyasa, TBSA-EK (1994) 160; Argent *et al.* (eds.), MNDT-CK 1 (1997) 340.

Trees or rarely shrubs, often with large buttresses. **Stipules** absent or rudimentary, caducous. **Leaves** spirally arranged, *generally well-spaced along twigs*, glabrous; *base attenuate*, *slightly decurrent* to *decurrent*, *often extending down along the entire length of petiole*, *margin crenulate-serrate* to *entire*, apex often acuminate, obtuse, sometimes emarginate; *midrib prominent beneath*, *flattened above*; *petiole not thickened at insertion*. **Inflorescences** *terminal*, spikes or racemes (flowers sometimes solitary), *generally short*, *erect and few-flowered*; bracts and bracteoles subpersistent. **Flowers** radially symmetrical; buds globular, tribracteate; hypanthium a turbinate or campanulate tube; calyx lobes imbricate in bud with gibbose margin between lobes, persistent; petals 4, free, imbricate in bud, adnate to the staminal tube at base, caducous; stamens numerous, longer than petals, in whorls with innermost one sterile, filaments fused at base, fusiform, anthers basifixed; intrastaminal disk present, epigynous; ovary turbinate, inferior, adnate to calyx tube, 3–4-loculed, style persistent; *ovules* anatropous, *numerous*, *horizontally inserted down the length of central placenta*, biseriate or irregular. **Fruits** fibrous berries, *3–15-seeded*, without pulp, 1–4-loculed; pericarp fibrous; endocarp coriaceous. **Seeds** ovoid, smooth or angular; endosperm absent; *embryo coiled*, *with folded* and crumpled *foliaceous cotyledons*; germination epigeal.

Vernacular name. Sabah—*putat paya* (Malay).

Distribution. Eight species ranging from the Andaman Islands to N Australia, including Malesia and the Solomon Islands. Three of the eight species occur in Borneo, and two occur in Peninsular Malaysia.

Uses. Timber is used locally for temporary construction, not durable.

Taxonomy. The horizontal ovules characteristic of *Planchonia* suggest this genus is more closely related to *Careya* Roxb. than to *Barringtonia* J.R. & G.Forst. and *Chydenanthus* Miers. The genus differs from all others in the subfam. Planchonioideae in that its embryo consists of a spirally coiled radicle with foliaceous cotyledons.

Key to *Planchonia* species

1. Leaves coriaceous, margin entire to finely serrate-crenulate; intercostal venation obscure. Flowers in spikes to 8 cm long; calyx lobes not persistent on fruit...**2. P. grandis**
Leaves chartaceous, margin coarsely serrate-crenulate; intercostal venation distinct. Flowers solitary or in racemes to 13.5 cm long (rarely longer); calyx lobes persistent on fruit..2

2. Leaves oblanceolate, base undulating and decurrent. Fruits globose, with basal stalk of 2–3 mm long..**1. P. brevistipitata**
Leaves obovate to ovate, base slightly decurrent. Fruit ovoid to ellipsoid, without basal stalk..**3. P. valida**

1. **Planchonia brevistipitata** Kuswata Fig. 4.

(Latin, *brevi* = short, *stipitatus* = provided with a stipe or little stalk; referring to flower and fruit)

Bull. Bot. Surv. India 7 (1965) 179, Reinwardtia 11 (1998) 191; Whitmore, Tantra & Sutisna *l.c.* 193; Argent *et al.* (eds.) *l.c.* 340. **Type:** *Amdjah 256*, Borneo, Kalimantan, Berau, Sedalir (holotype BO; isotype L). **Synonym:** *Barringtonia belagaensis* P.Chantaranothai, Kew Bull. 50 (1995) 695.

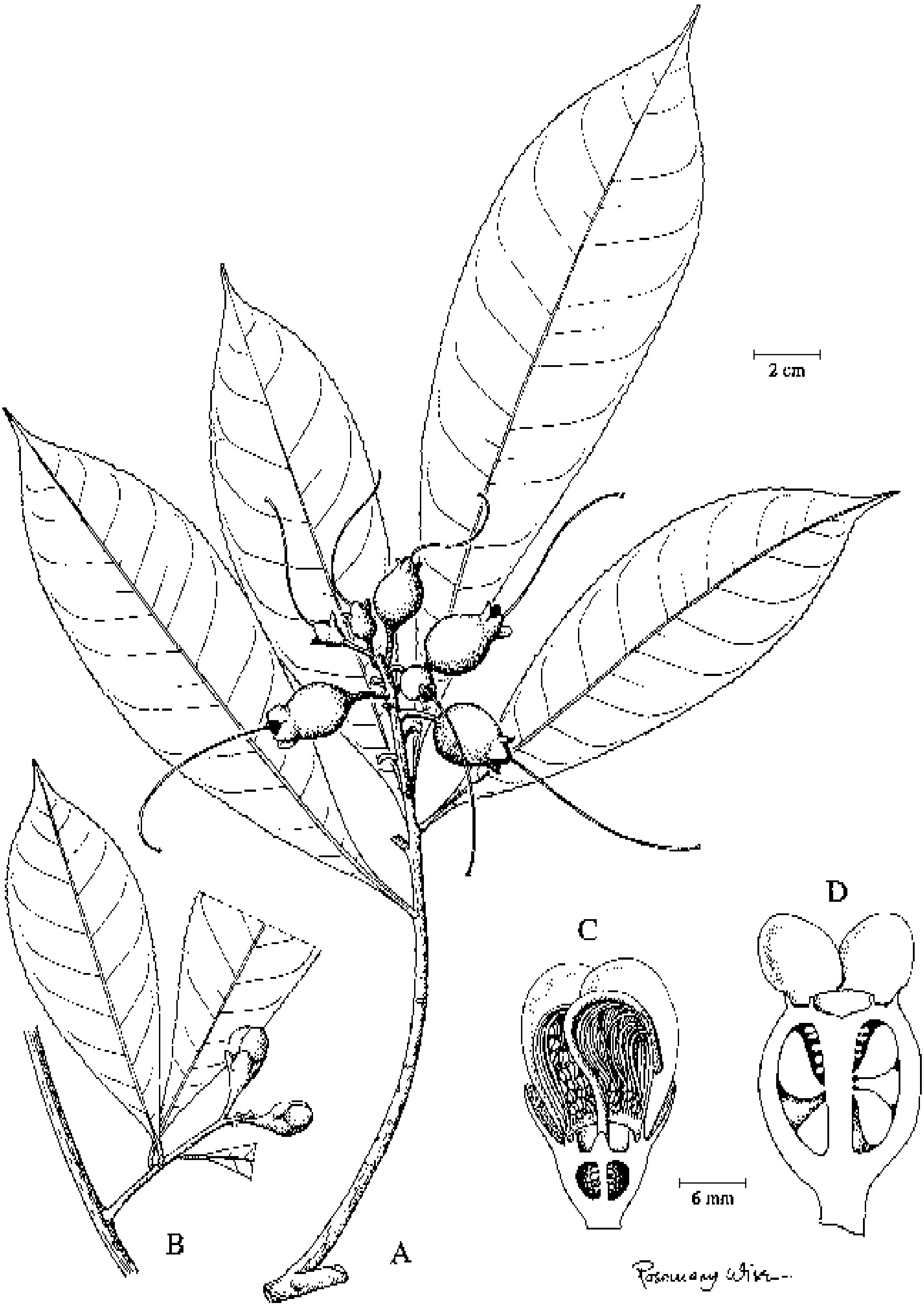

Fig. 4. *Planchonia brevistipitata*. A, fruiting (young) leafy twig; B, flowering leafy twig; C, longitudinal section of flower bud; D, longitudinal section of developing young fruit showing many developing ovules/seeds. (A and D from *SAN 64340*, B–C from *S 43541*.)

Small tree to 15 m tall. **Twigs** slender, *c.* 5 mm diameter, greyish brown, finely grooved, set with conspicuous leaf scars. **Bark** greyish to brown, smooth to flaky; inner bark light brown to reddish grey. **Sapwood** pale brown. **Stipules** lacking. **Leaves** *chartaceous*, glabrous; *oblanceolate*, 8–25 × 2–6 cm, *base undulating and decurrent*, *margin coarsely serrate-crenulate*, apex acuminate, acumen to 2 cm long; midrib strongly prominent beneath, prominulous above; lateral veins (8–)12–18(–20) pairs, prominent beneath, prominulous above; *intercostal venation* densely reticulate, *distinct beneath*, faint above; petiole slightly winged, 0.5–1 cm long. **Inflorescences** *racemose*, few–many-flowered; *rachis to 13.5 cm long*, *c.* 3 mm diameter, angular, glabrous. **Flowers:** hypanthium 6–10 mm long, funnel-shaped, slightly tetrangular; pedicel 3–10 mm long, 1–2 mm diameter; calyx lobes 4, connate at base, orbicular, *c.* 9 × 7 mm; petals 4, orbicular; stamens in 5–6 whorls; ovary 4-loculed, style *c.* 7 cm long, stigma lobed. **Fruits** *globose*, 2–3 × 1.5–2 cm, slightly ribbed at base, *with slender stalk of 2–3 mm long*, 4–11-seeded; *calyx* and style *persistent*. **Seeds** irregularly elongate-ovoid, 3-angular, 7–9 × 3–5 mm; seed coat silvery brown, coriaceous.

Vernacular name. Sabah and Sarawak—*putat paya* (Malay).

Distribution. Endemic to Borneo, and known from Sabah (Beaufort, Kinabatangan, Kudat, Lamag, Lahad Datu, and Tenom districts; e.g., *SAN 25982*, *SAN 64340*, *SAN 84810*, *SAN 107297*, and *SAN 128015*), Sarawak (Baram district; e.g., *Chew CWL 1071*, *Chin 2887*, *S 41360*, and *S 43451*) and Kalimantan (e.g., *Amdjah 256*).

Ecology. Common in riverine and lowland mixed dipterocarp forests on sandy, rocky soils.

2. **Planchonia grandis** Ridl.

(Latin, *grandis* = large, great, tall, lofty; referring to the habit)

J. Str. Br. Roy. As. Soc. 61 (1912) 9, *l.c.* (1922) 760; Kuswata *l.c.* (1965) 185; Burkill *l.c.* 1797; Whitmore *l.c.* 264; Whitmore, Tantra & Sutisna *l.c.* 193; Turner *l.c.* 289. **Type:** *Ridley 6423*, Singapore (holotype K; isotypes BO, CAL, SING).

Tree to 33 m tall, 1 m diameter; bole sometimes fluted, often with buttresses. **Bark** reddish brown, grey, or black, vertically grooved, becoming scaly; inner bark soft and spongy, pink to reddish orange, fibrous, sticky. **Twigs** smooth to striate, *c.* 4 mm diameter, set with distinct leaf scars. **Leaves** *coriaceous*, lower surface dull, upper surface glossy; obovate to elliptic, 5–17 × 4–9 cm, base slightly decurrent, *margin entire* to *finely serrate-crenulate*, apex acuminate or cuspidate to broadly rounded; lateral veins obscure, 9–10(–15) pairs; *intercostal venation obscure*; petiole *c.* 1 cm long, wing much narrower on lower part, almost invisible, drying dark reddish-brown. **Inflorescences** spicate; *spike to 8 cm long*; rachis 5–8 mm diameter, glabrous; bracts ovate-oblong, to 15 × 7 mm. **Flowers:** hypanthium turbinate, not ribbed, *c.* 10 mm long; calyx lobes coriaceous, semi-orbicular; petals chartaceous, greenish white, *c.* 30 × 15 mm; staminal tube red; free filaments to 30 mm long, white; style up to 45 mm long. **Fruits** globose, *c.* 4 cm diameter, 3–more-seeded, fleshy, astringent, bitter; *calyx lobes non-persistent*. **Seeds** longitudinally compressed, not angular, *c.* 1.5 cm long; seed coat coriaceous, brown.

Vernacular name. Sabah—*putat* (Malay).

Distribution. Sumatra, Peninsular Malaysia, and Borneo. In Borneo, occurs in Sabah (Kudat, Labuk Sugut and Sipitang districts; e.g., *SAN 48513*, *SAN 50312*, *SAN 76112*, *SAN 86760*, and *SAN 96881*) and Kalimantan (e.g., *bb. 11536*, *bb. 15280*, *bb. 26036*, *bb. 27001*, and *bb. 34272*).

Ecology. Primary lowland mixed dipterocarp forest and forest bordering mangroves.

3. **Planchonia valida** (Blume) Blume

(Latin, *validus* = strong, robust-growing; referring to the tree)

In Van Houtte, Fl. Serr. 7 (1851) 24; Ridley *l.c.* (1922) 760; Cockburn *l.c.* 49; Kuswata *l.c.* (1965) 168; Burgess, TBS (1966) 342; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 193. **Basionym:** *Pirigara valida* Blume, Bijdr. Fl. Ned. Ind. (1826) 1096. **Type:** *Blume 233*, Java (holotype L). **Synonyms:** *P. alata* Blume *l.c.* (1851) 25; *P. sumatrana* Blume *l.c.* (1851) 25; *P. littoralis* Blume *l.c.* (1851) 25; *P. sundaica* Miq., Fl. Ind. Bat. 1, 1 (1855) 493; *P. undulata* Teijsm. & Binn., Nat. Tijdschr. Ned. Ind. 29 (1866) 256; *P. elliptica* Miers, Trans. Linn. Soc. London 2, 1 (1875) 93, Merrill *l.c.* 143; *P. forbesii* Knuth, Pflanzenreich 105 (1939) 54.

Large tree to 50 m tall, 2 m diameter; bole straight; buttresses to 4 m tall. **Twigs** angular, with distinct leaf scars and scattered lenticels. **Bark** grey-brown, 2–6 mm thick, scaling off in small irregular pieces; inner bark 10–15 mm thick, inner white. **Sapwood** greyish white to pale yellow, distinct from heartwood which is dark red with coloured bands. **Stipules** early caducous, subulate, *c.* 0.4 × 0.1 mm. **Leaves** *chartaceous*, glossy, turning red before falling, glabrous; *ovate* to *obovate*, (3–)6–25(–35) × (2.5–)4.5–13 cm, *base slightly decurrent*, *margin coarsely serrate-crenulate*; apex acuminate, acumen to 15 mm long, obtuse; lateral veins distinct, irregular; *intercostal venation distinct*, densely reticulate with the veinlets ending in a mucro near or at the tip of the tooth of the crenulation. **Inflorescences** *racemose*; *rachis to 13.5 cm long* (rarely to 30 cm), generally many-flowered, puberulous to glabrous, 2–5(–7) mm diameter; pedicel 2–10 mm long, 2–5 mm diameter; bracts oblong to semi-orbicular, 7.5–10(–15) × 5 mm. **Flowers:** hypanthium campanulate, ribbed, puberulous to glabrous; calyx lobes coriaceous, pale green, ovate, 7–10 × 4–8 mm; petals membranaceous, green, reflexed, obovate-oblong; staminal tube *c.* 10 mm long, pink to red at base, yellow to white distally; disk *c.* 1 mm high; style slender, 30–60 mm long. **Fruits** *ovoid* to *ellipsoid*, 3–4 × 1.5–2.5 cm, 1–15-seeded, covered with powdery granules, *without basal stalk*; pericarp to 7 mm thick, fibrous; *calyx lobes persistent*. **Seeds** ovoid, 3–4-angular; seed coat pale brown, coriaceous.

Vernacular names. Sabah—*putat paya* (Malay), *selangan kangkong* (Kadazan).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, Bali, Lombok, and Timor. In Borneo, occurs in Sabah (all districts; e.g., *SAN 15271*, *SAN 19584*, *SAN 21773*, and *SAN 27260*) and Kalimantan (e.g., *bb. 11706*, *bb. 15207*, *bb. 26251*, *Kostermans 5000*, and *Kostermans 6763*).

Ecology. Common in seasonally flooded forest and in lowland and hill mixed dipterocarp forests, at altitudes to 1000 m.

Uses. Timber of medium density but not strong or durable, warps severely, used locally for various purposes. Young leaves and red shoots can be eaten as a vegetable, raw or steamed.

OLEACEAE

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King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 254; Merrill, EB (1921) 488; Ridley, FMP 2 (1923) 310; Masamune, EPB (1942) 610; Backer & Bakhuizen *f.*, FJ 2 (1965) 212; Anderson, CLTS (1980) 284; Corner, WSTM 3rd. edition 2 (1988) 601; Kiew, TFM 4 (1989) 285; Coode *et al.* (eds.), CLBD (1996) 247; Argent *et al.* (eds.), MNDT-CK 2 (1997) 487.

Trees, shrubs or climbers, evergreen, glabrous or pubescent. **Stipules** absent. **Leaves** opposite (rarely alternate), simple, trifoliate or pinnate, margin entire (sometimes toothed). **Inflorescences** basically cymose but often appearing racemose, paniculate or spicate (rarely flowers solitary), axillary, terminal, rarely ramiflorous. **Flowers** bisexual, sometimes polygamous or unisexual, radially symmetrical; calyx usually small or campanulate and undivided or divided into 4–(5–15) lobes or teeth; corolla gamopetalous with a long or short tube, or divided to base or petals joined in pairs at base, (2–)4(–12)-lobed, lobes imbricate or valvate-induplicate; stamens 2 (rarely 3 or 4), alternating with petals, epipetalous or inserted at base of corolla tube, filaments short or sometimes long, anthers oblong, dorsifixed, 2-loculed, dehiscing longitudinally, connective sometimes apiculate; disc absent; ovary superior, 2-loculed, styles usually short, rarely long, stigma capitate to shortly bifid; ovules 2 per locule, rarely 1 or 4–8, basally, laterally or apically attached, anatropous, rarely amphitropous. **Fruits** drupaceous (in *Chionanthus* and *Olea*), capsules (in *Schrebera*), or 2-lobed berries (in *Jasminum*). **Seeds** 1–4, erect or pendulous; testa thin (rarely fleshy); endosperm fleshy, horny, oily or absent; embryo straight, cotyledons in albuminous seeds thin, oblong-ovate, in exalbuminous seeds thick and fleshy; radicle short, rarely long.

Distribution. About 25 genera and 600 species worldwide in tropical, subtropical and temperate regions but mostly in the Old World. In Sabah and Sarawak, 6 genera and 47 (including three incompletely known) species are recorded.

Ecology. Apart from mangrove forest, species are found in all forest types from the lowlands to the summit of mountains but most species are uncommon, although a few are widespread.

Uses. A few exotic species of *Jasminum* are cultivated, especially *J. sambac* (L.) W.Ait. for its heavily scented flowers. Species of *Chionanthus*, *Ligustrum*, *Olea*, and *Schrebera* are trees but most are small, some are shrubby and none is either common or large enough to be a timber tree.

Key to genera

1. Climbing plants or scandent shrubs..2
   Trees or shrubs..4

2. Leaves trifoliate or unifoliolate (i.e. the stalk is jointed indicating the blade represents a terminal leaflet). Corolla tube narrow, at least 6 mm long, with (4–)6 or more spreading lobes. Fruits bilobed..

   Jasminum L.

   (Latinised Persian plant name—*jasmin*)

   Sp. Pl. 1 (1753) 7; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 255; Ridley, FMP 2 (1923) 310; Backer & Bakhuizen *f.*, FJ 2 (1965) 216; Kiew, Sandakania 4 (1994) 75, *ibid.* 5 (1994) 1; Coode *et al.* (eds.), CLBD (1996) 248.

   Mostly tropical and Old World, about 450 species. In Borneo, 12 species, of which 10 occur in Sabah and Sarawak.

   Climbers or *scandent shrubs*, glabrous or pubescent. *Leaves unifoliolate* or *trifoliate*. Inflorescences terminal or axillary, cymose or paniculate (rarely flowers solitary). Flowers bisexual and *heterostylous*; calyx joined at base with long or short lobes 4–10 mm long; *corolla tube narrow*, *at least 6 mm long*, white sometimes tinged rosy purple, *lobes 4 to many*, imbricate in bud; stamens with short filaments, inserted within corolla tube; ovary with long or short styles. *Fruits strongly bilobed* and 2-seeded, endosperm absent. Usually in lowlands on forest margins, along rivers, in disturbed forest, on hill tops to 1900 m altitude.

   Leaves simple. Corolla tube short with 4 lobes. Fruits not bilobed..................3

3. Twigs quadrangular. Leaves with 3 longitudinal veins......................................

   Myxopyrum Blume

   (Greek, *muxa* = mucus or slime, *puros* = wheat or fruit; referring to the mucilagenous fruit)

   Bijdr. Fl. Ned. Ind. (1826) 683; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 272; Ridley, FMP 2 (1923) 320; Backer & Bakhuizen *f.*, FJ 2 (1965) 215; Kiew, Blumea 29 (1984) 499; Coode *et al.* (eds.), CLBD (1996) 248.

   Four species from India, Indo-China and China (Hainan), throughout Malesia to New Britain. In Sabah and Sarawak two species, *M. nervosum* Blume subsp. *coriaceum* (Blume) Kiew and *M. pierrei* Gagnep.

   Twining climbers or *scandent shrubs*. *Twigs acutely quadrangular*. *Leaves simple*, narrowly lanceolate or ovate or cordate, *triplinerved*, margin entire or toothed towards apex. Inflorescences terminal and axillary, cymose panicles. Flowers sessile, small, bisexual; calyx shortly tubular, lobes 4, short and acute; *corolla tube and lobes short*, lobes valvate in bud; stamens subsessile with anthers contained within corolla tube; ovary with subsessile stigma. Fruits globose, *not bilobed*, with 1 or 2 endospermic seeds.

   Twigs terete. Leaves with pinnate venation..
   ....**1. Chionanthus** (in part; **C. macrobotrys**)

4. Leaves pinnate. Flowers to 20 mm long; corolla lobes (4–)6–8. Fruits woody 2-valved capsules with winged seeds..**4. Schrebera**

Leaves simple. Flowers to 8 mm long; corolla lobes 4. Fruit fleshy and drupaceous; seeds not winged……………………………………………………………5

5. Inflorescences terminal; style 1–2 mm long……………………………**2. Ligustrum**
Inflorescences usually axillary, sometimes ramiflorous; style very short, stigma sessile or subsessile………………………………………………………6

6. Leaves entire or serrate. Flowers polygamous; flower buds rounded, corolla tube equal to or slightly longer than lobes………………………………………………**3. Olea**
Leaves always entire. Flowers bisexual (except in *C. polygamus*); flower buds pointed (except in *C. balgooyiana* and *C. ramiflorus*); corolla divided to base into 4 lobes joined in pairs, rarely with corolla tube and then shorter than the lobes…………………
…………………………………………………………**1. Chionanthus** (in part)

1. **CHIONANTHUS** L.

(Greek, *chion* = snow, *anthos* = flower, referring to white flower)

mok (Iban)

Sp. Pl. 1 (1753) 8; Stearn, Ann. Missour. Bot. Gard. 63 (1976) 355; Kiew, Malay. For. 42 (1979) 259, *ibid.* 43 (1980) 362, *ibid.* 44 (1981) 143, TFM 4 (1989) 286; Corner, WSTM 3rd. edition 2 (1988) 601; Coode *et al.* (eds.), CLBD (1996) 247; Argent *et al.* (eds.), MNDT-CK 2 (1997) 487. **Synonym:** *Linociera* Sw. *in* Schreber, Gen. 2 (1791) 784, Ridley, FMP 2 (1923) 316, Anderson, CLTS (1980) 284.

Trees or *shrubs*, rarely scandent climbers. **Leaves** *simple with entire margin*, *pinnately veined*, surface appearing glabrous but minutely punctate from sunken lepidote trichomes. **Inflorescences** *axillary*, *rarely ramiflorous* or terminal, much branched panicle, racemose or short and spicate; bracts scarious sometimes foliaceous, usually caducous. **Flowers** *to 8 mm long*, *bisexual* (rarely polygamous, *C. macrobotrys* and *C. polygamus*), white or yellow, fragrant; *buds pointed* (except in *C. balgooyiana* and *C. ramiflorus*); calyx shallowly 4-lobed, persistent, pubescent or glabrous; *corolla 4-lobed*, *lobes usually free to base and joined in pairs*, *rarely with distinct tube and then lobes longer than the tube*, induplicate (rarely valvate), frequently twisting at anthesis; stamens attached at the base where the corolla lobes are joined in pairs, subsessile or filament very short and anthers hardly exposed in open flower, anthers oblong, connective sometimes apiculate; ovary ovoid, *c.* 2 mm long, *style very short*, *stigma* slightly bilobed, *sessile.* **Fruits** *drupaceous*, smooth, ridged or pimply; *epicarp fleshy*, mesocarp and endocarp either drying thin and brittle, thick and leathery or woody. **Seeds** *not winged*, usually albuminous, if exalbuminous then cotyledons thick and fleshy.

Distribution. About 100 species, largely tropical with species in all continents. The two temperate species, which are cultivated as ornamentals, are deciduous and have large flowers with petals *c.* 2 cm long. Thirty (including three incompletely known) species are found in Sabah and Sarawak.

Ecology. As for family.

Key to *Chionanthus* species

1. Leaf base cordate……………………………………………**4. C. cordulatus**
Leaf base not cordate……………………………………………………2

2. Twigs quadrangular in cross-section. Fruit ridged and curved…….**6. C. curvicarpus**
Twigs round in cross-section. Fruit not curved, rarely superficially 4-ridged or longitudinally ridged or verrucose or rugose…………………………………3

3. Petiole drying brown or fawn…………………………………………4
Petiole drying black……………………………………………………7

4. Leaf apex cuspidate; lateral veins 5–8 pairs; petiole 0.5–1 cm long……………5
Leaf apex rounded to acuminate; lateral veins 8–15 pairs; petiole 1.5–3 cm long...6

5. Shrub to 2 m tall. Leaf 20–28 cm long, drying fawn to midbrown. Fruit ovoid, *c.* 0.4 cm long……………………………………………………………

C. longipetalus (Merr.) Kiew

(Latin, *longi-* = long, *petalus* = petal; with long petals)

Malay. For. 43 (1980) 379, *p.p.*, *l.c.* (1981) 152, *p.p.* Basionym: *Linociera longipetala* Merr., PEB (1929) 249, Masamune, EPB (1942) 612. Type: *Elmer 20455*, Borneo, Sabah, Tawau (holotype K; isotype L).

Shrub 1–2 m tall. Twigs round in cross-section, drying pale brown, nodes slightly flattened, minutely lenticellate, glabrous. *Leaves* subcoriaceous, glabrous, *drying fawn* or *midbrown*, with lateral veins darker than leaf blade beneath; lanceolate to broadly lanceolate *20–28* × *8–11 cm*, *base cuneate* to *rounded*, margin slightly recurved, *apex cuspidate*, acumen 1–1.5 cm long; midrib slightly raised above, prominent beneath; *lateral veins 6–8 pairs*, plane above and prominent beneath, marginal vein *c.* 3 mm from margin; *petiole 0.5–1 cm long*, thickened, *drying fawn*. Inflorescences axillary, solitary, racemose with 2–3 pairs of widely spaced flowers, 0.6–1 cm long; peduncle *c.* 2 mm long, glabrous; bracts scarious, *c.* 1 mm long, minutely pubescent, persistent. *Flowers* bisexual, white; pedicel 0.5–1 mm long; buds pointed; calyx *c.* 0.5 mm long, deeply divided, lobes acute, glabrous; corolla 7–12 mm long, divided almost to the base, lobes narrowly linear, sometimes twisted at anthesis; stamens inserted on the corolla tube by thick filaments of 0.5–1 mm long, anthers oblong-ovate, 1–1.5 mm long; ovary oblong-ovoid, *c.* 2 mm long, glabrous, stigma narrowly notched. *Fruits* (immature) *ovoid*, *c. 0.4* × *0.3 cm*, *not curved or ridged*.

Endemic to Borneo. In Sabah, only known from the type collection in Tawau and *SAN 90114* from Tingkayu in Kunak district. Also known in E Kalimantan (e.g., *Endert 2788*, *Endert 3039*, *Kostermans s.n.*, *Kostermans 10460*). In lowland mixed dipterocarp forest, to 150 m altitude.

Tree 3–17 m. Leaf 10–17 cm long, drying pale grey-green. Fruit globose, *c.* 1.8 cm long……………………………………………………**25. C. spicatus**

6. Twigs stout. Leaf larger, 23–38 × 7–13 cm; lateral veins obscure beneath. Inflorescence ramiflorus. Fruit ovoid, smooth, *c.* 2.5 × 2 cm……………**3. C. callophyllus**
Twigs slender. Leaf smaller, 17–28 × 6–10 cm; lateral veins conspicuous beneath. Fruit ellipsoid, superficially 4-ridged, *c.* 3 × 1.5 cm……………**2. C. callophylloides**

7. Leaf thickly coriaceous……………………………………………………………8
Leaf coriaceous, subcoriaceous or chartaceous…………………………………13

8. Petiole to 0.7 cm long. Inflorescence racemose, *c.* 0.5 cm long…….**15. C. palustris**
Petiole 1 cm or longer. Inflorescence paniculate, 1–11 cm long…………………9

9. Leaf obovate to oblong-lanceolate, base strongly tapering…………………………10
Leaf lanceolate to broadly elliptic, base cuneate or rounded……………………11

10. Lower leaf surface rugose, lateral veins obscure beneath. Fruit ellipsoid, 3.5–4.5 cm long………………………………………………………………**7. C. evenius**
Lower leaf surface smooth, lateral veins prominent beneath. Fruit globose, 2–2.5 cm diameter… ……………………………………………………………**8. C. globosus**

11. Leaf to 14 × 6 cm. Flowers in tight clusters, densely brown hairy. Fruit ovoid, *c.* 2.5 cm long……..……………………………………………………...**18. C. polycephalus**
Leaf 14–30 × 5.5–13 cm. Flowers spaced, sparsely pubescent. Fruit globose, 1.5–1.8 cm diameter……………………………………………………………………12

12. Lateral veins 7–8 pairs, plane and obscure on upper surface….……...**11. C. leopoldi**
Lateral veins 8–14 pairs, deeply impressed on upper surface....**14. C. pachyphyllus**

13. Inflorescence (or infructescence) racemose……………………………………14
Inflorescence (or infructescence) paniculate………………………………………18

14. Leaf surface conspicuously glossy, slightly bullate (drying wrinkled) above………… ……………………………………………………………**12. C. lucens** (in part)
Leaf surface dull and plane above…………………………………………………15

15. Intercostal veins forming a conspicuous network on lower leaf surface………………… ……………………………………………………………**10. C. kinabaluensis**
Intercostal veins obscure……………………………………………………………16

16. Leaf apex bluntly rounded into the acumen. Fruit *c.* 2.5 cm long…...**9. C. havilandii**
Leaf apex cuspidate. Fruit to 1.2 cm long…………………………………………17

17. Leaf oblong-ovate, base rounded to cuneate; lateral veins obscure beneath. Fruit smooth…………………………………………………………………**5. C. crispus**
Leaf lanceolate, base tapered; lateral veins prominent beneath. Fruit rugose………… ……………………………………………………………………**23. C. rugosus**

18. Leaf obovate…………………………………………………………………………19
Leaf lanceolate, broadly elliptic or oblong…………………………………………21

19. Intercostal veins prominent in dry leaf. Flower buds rounded. Fruit *c.* 2 cm long, with thin pericarp……………..…………………………………**22. C. ramiflorus** (in part)
Intercostal veins obscure. Flower buds pointed. Fruit 4.5–6 cm long, with thick pericarp ……………………………………………………………………20

20. Petiole 1.5–3 cm long. Peduncle less than half the length of inflorescence. Fruit smooth..**13. C. macrocarpus**
Petiole 2.5–5.5 cm long. Peduncle more than half the length of inflorescence. Fruit deeply ridged..**20. C. porcatus**

21. Leaf coriaceous. Flowers polygamous...22
Leaf chartaceous to subcoriaceous. Flowers bisexual................................23

22. Tree 12–30 m tall. Calyx grey hairy. Fruit pear-shaped, *c.* 1.2 cm long..**19. C. polygamus**
Scandent, sometimes shrubby plants. Calyx not grey hairy. Fruit not pear-shaped...
C. macrobotrys (Merr.) Kiew
(Greek, *makro* = large, *botrys* = bunch; referring to the inflorescence)
J. Arn. Arb. 64 (1983) 620. Basionym: *Linociera macrobotrys* Merr., Philip. J. Sci. Bot. 13 (1918) 117. Type: *Foxworthy 367*, Borneo, Sarawak, G. Pueh (holotype A). Synonyms: *Linociera scandens* Merr., Philip. J. Sci. 37 (1928) 189, *syn. nov.* Type: *Ramos & Edano BS 45740*, the Philippines, Luzon, Mt. Alzapan (holotype A); *Myxopyrum enerve* van Steenis, Blumea 15 (1967) 152; *Chionanthus enerve* (van Steenis) Kiew, J. Arn. Arb. 64 (1983) 622, *syn. nov.* Type: *Asah S 22740*, Borneo, Sarawak, Mt. Dulit (holotype L; isotypes A, K).
Twigs round in cross-section, greyish brown. *Leaves coriaceous*, glabrous, punctate beneath; *lanceolate* to slightly ovate, 4–12.5 × 1.5–6.5 cm, *base rounded* to *truncate*, margin entire and recurved, apex acute to acuminate; midrib impressed above; lateral veins 4–8 pairs, obscure on both surfaces; *petiole drying black*. *Inflorescences* axillary, sometimes terminal, *paniculate* with up to fourth-order branching, 3–15 cm long. *Flowers polygamous*; buds rounded. *Fruits ovoid*, *c.* 0.7 × 0.6 cm, *not curved or ridged.*
Borneo and the Philippines. In Borneo, recorded from Sabah (e.g., *Carr 27662A*, *Carr 27905*, *Clemens 30910*, *Clemens 40704A*, *Clemens 50128*, and *RSNB 4499*), Sarawak (e.g., *Argent & Jermy 1015*, *S 33831*, *S 33950*, *S 44617*, and *S 50866*), Brunei (e.g., *Coode 7433* and *Wong WKM 730*), and Kalimantan (e.g., *Hallier 688*, *Hallier 709* and *Kostermans 13083B*). In montane forest at 1100–2500 m alitutde; once collected from limestone habitat (G. Api, Sarawak).

23. Panicle with second or third order branching.......................................24
Panicle with first order branching..25

24. Leaf drying chestnut-brown; petiole 0.5–1.5 cm long. Flower buds pointed; flowers crowded at tips of inflorescence branches. Fruit wall (pericarp) pimply (verrucose) and thick..**17. C. pluriflorus**
Leaf drying greenish brown; petiole 1.5–3 cm long. Flower buds rounded; flowers spaced. Pericarp smooth and thin...............................**22. C. ramiflorus** (in part)

25. Leaf glossy above, slightly bullate (drying wrinkled) above......**2. C. lucens** (in part)
Leaf dull and plane above..26

26. Leaf widest in the lower half; apex strongly cuspidate. Fruit *c.* 0.9 cm long, minutely rugose...**1. C. balgooyiana**
Leaf widest at the middle; apex acute, acuminate to cuspidate. Fruit 1.5–2.3 cm long, smooth...27

27. Leaf drying dark chestnut-brown; lateral veins conspicuously darker than leaf blade beneath……………………………………………**16. C. plurifloroides**
Leaf drying greenish grey or greenish brown; lateral veins concolorous or slightly darker than leaf blade beneath……………………………………………28

28. Leaf narrowly lanceolate, 14–21.5 × 3.5–6 cm. Panicles 7–13 cm long. Fruit globose…. ……………………………………………**25. C. sabahensis**
Leaf broadly elliptic to lanceolate, 6–15 × 2.5–5.5 cm. Panicles 1.5–5 cm long. Fruit ovoid……………………………………………**21. C. pubicalyx**

1. **Chionanthus balgooyiana** Kiew Fig. 1.

(Max M.J. van Balgooy, botanist and plant geographer, National Herbarium of the Netherlands, Leiden Branch, the Netherlands)

TFSS 4, App. (2002) 351. **Type:** *Martin S 38039*, Borneo, Sarawak, G. Mulu (holotype SAR; isotypes K, KEP, SAN, SING).

Tree to 20 m tall and 35 cm diameter; bole with low buttresses *c.* 20 cm tall. **Bark** greyish green or dark brown, flaky. **Twigs** slender, *round in cross-section*, drying greyish white, flattened at nodes when young, lenticellate, glabrous. **Leaves** *subcoriaceous*, *dull and plane above*, drying greyish green, very sparsely pubescent; *narrowly lanceolate*, 7–8.5 × 2–3.5 cm, *widest in the lower half*, *base cuneate*, margin recurved, *apex strongly cuspidate*, acumen 0.75–1.5 cm long; midrib raised above, plane beneath; lateral veins 4–6 pairs, plane and obscure on both surfaces, marginal vein absent; *petiole* 0.5–1 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *panicle with first order branching*, (0.5–)1–2.75 cm long, branch *c.* 3 mm long with 2–4 spaced pairs of flowers; peduncle 2–4 mm long, glabrous; bracts scarious, *c.* 1 mm long, glabrous, persistent. **Flowers** *bisexual*, white or greenish white; buds rounded; pedicel 1–3 mm long; calyx *c.* 1.5 mm long, divided more than halfway, lobes acute, glabrous; corolla 2–3.5 mm long, divided almost to base, lobes narrowly linear, involute, apex cucullate, straight at anthesis; stamens almost sessile, epipetalous, anthers rotund, *c.* 0.5 mm long, without apiculum; ovary conical, *c.* 1.25 mm long, glabrous, stigma bilobed. **Infructescences** *c.* 1.25 cm long, slightly thickened. **Fruits** (?immature) ovoid, *c. 0.9 × 0.6 cm, not curved*, *minutely rugose*, apex rounded, base tapered; stalk *c.* 3 mm long, slightly thickened. **Seeds** unknown.

Distribution. Endemic to Borneo, known in Sarawak only from Bt. Senyandang in the Second Division (e.g., *S 44254*), Dulit Range in the Fourth Division (e.g., *Richards 1706*, *Richards 1773*, *S 34896*, and *S 46777*) and G. Mulu (the type).

Ecology. In hill to lower montane forest on steep slopes, at 650–1400 m altitude.

2. **Chionanthus callophylloides** Kiew

(Greek, -*oides* = like; referring to its resemblance to *C. callophyllus*)

TFSS 4, App. (2002) 351. **Type:** *Saikeh SAN 79917*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype SAN; isotype SING).

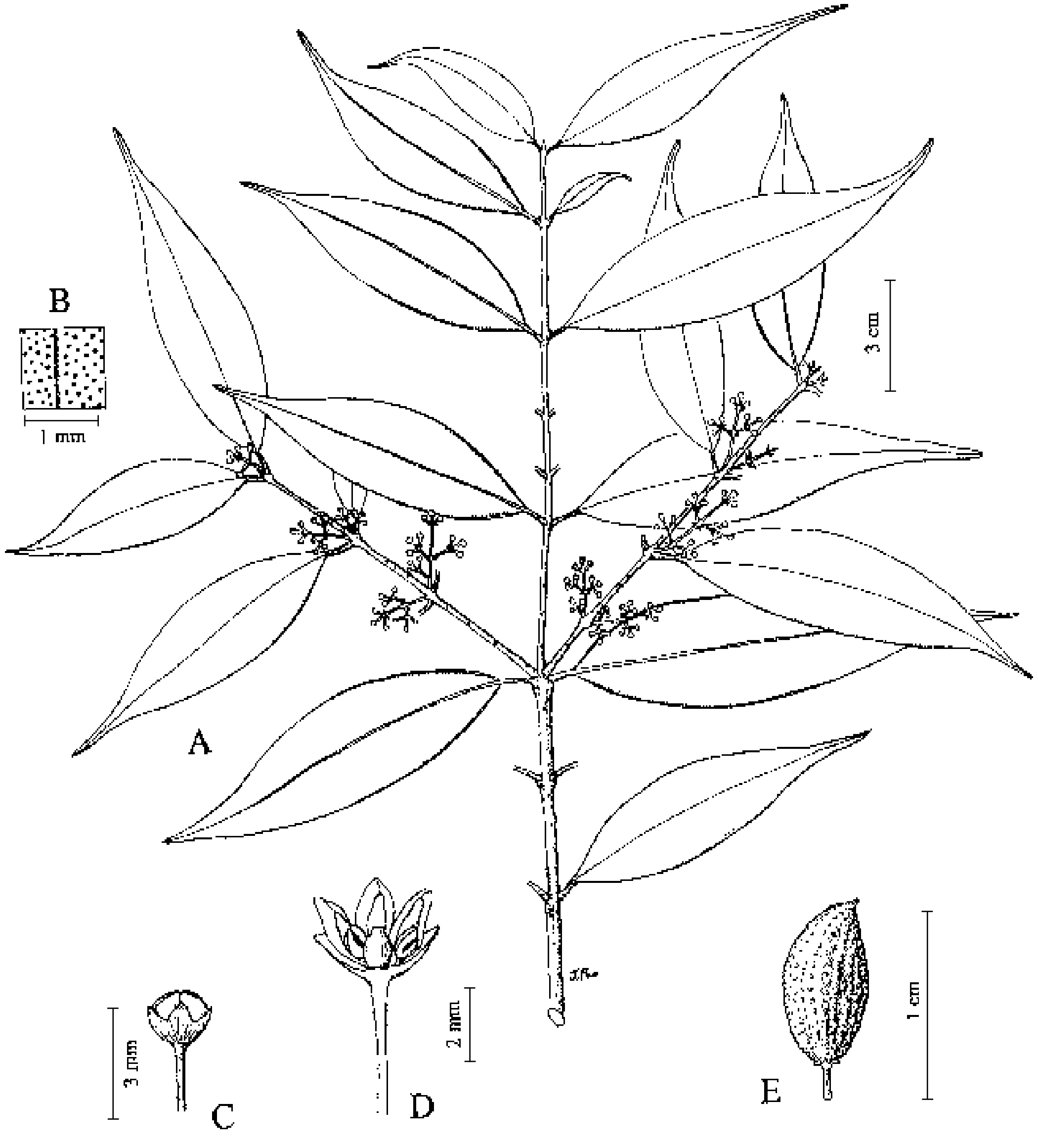

Fig. 1. *Chionanthus balgooyiana*. A, flowering leafy twig; B, detail of upper leaf surface; C, flower bud; D, open flower with one calyx lobe and one corolla lobe removed; E, young fruit. (A–D from *S 34896*, E from *S 38039*.)

Tree to 13 m and 25 cm diameter. **Bark** brown, minutely fissured; inner bark yellowish pink. **Sapwood** pinkish. **Twigs** *slender*, *round in cross-section*, glabrous, older twigs drying pale grey, nodes flattened, lenticels conspicuous in young green twigs, disappearing with age, leaf scars large, horseshoe-shaped. **Leaves** subcoriaceous, glabrous, drying grey-green above and fawn beneath; narrowly obovate, (*17.5–*)*27*(*–28*) × (*6–*)*8*(*–10*) *cm*, *base tapered*, margin slightly recurved, *apex acuminate*, acumen 1–2 cm long; midrib impressed above, prominent beneath; *lateral veins 9–11*(*–15*) *pairs*, impressed or plane above, *conspicuous beneath*, marginal vein conspicuous and 2–3 mm from margin; *petiole 1.75–2.5 cm long*, thickened, deeply grooved above, *drying brown*. **Inflorescences** *c.* 1 cm long, glabrous. **Flowers** unknown. **Infructescences** (young) racemose panicle, solitary, axillary, 2–3 cm long, lowest branch *c.* 1.5 cm long, upper branch *c.* 0.5 cm long; peduncle 2–5 mm long; bracts scarious. **Fruits** *ellipsoid*, *c. 3 × 1.5 cm*, *not curved*, *superficially 4-ridged*, apex acute or rounded, base truncate, immature fruits blue green, drying with white bloom; stalk thickened; pericarp rough, *c.* 1.5 mm thick but not woody when dry. **Seeds** endospermous.

Distribution. Endemic to Borneo. In Sabah, known from Lahad Datu, Pitas, Ranau, Sandakan, and Tenom districts (e.g., *SAN 12142*, *SAN 35605*, *SAN 72028*, *SAN 92435*, *SAN 120061*, and *SAN 132640*). In Sarawak, recorded from Ulu Sg. Berar, G. Mulu (e.g., *S 39633*).

Ecology. Lowland mixed dipterocarp forest, often in flat swampy (fresh water) lands, at *c.* 20 m altitude.

3. **Chionanthus callophyllus** Blume

(Greek, *calos* = beautiful; *phullon* = leaf)

Mus. Bot. Lugd. Bat. 1 (1850) 319; Kiew, Gard. Bull. Sing. 37 (1984) 210, *l.c.* (1989) 287. **Lectotype** (Kiew, 1984)**:** *Korthals s.n.* (= *RHL Sheet No. 908158933*), Borneo, without locality (hololectotype L). **Synonyms:** *Linociera paludosa* King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 268, Merrill, EB (1921) 489, Ridley *l.c.* (1923) 316, Masamune *l.c.* 612; *Olea platycarpa* King & Gamble *l.c.* 271; *C. platycarpus* (King & Gamble) Kiew, Malay. For. 42 (1979) 272, *l.c.* (1981) 149.

Tree or shrub, 3–30 m tall, to 30 cm diameter. **Bark** rough or scaly, white, grey or brown; inner bark orange-brown to red. **Sapwood** white or yellow. **Twigs** *stout*, *round in cross-section*, drying white, nodes flattened with large horseshoe-shaped leaf scars, glabrous, lenticellate. **Leaves** clustered at ends of twigs, slightly subcoriaceous, glabrous, drying grey or pale brown; obovate to oblong-lanceolate, *23–38 × 7–13 cm*, *base tapered* or *cuneate*, margin slightly recurved, *apex rounded* to *shortly acuminate*; midrib plane above; *lateral veins 8–13 pairs*, impressed above, *obscure beneath*, marginal vein 3–5 mm from margin; *petiole 1.5–3 cm long*, stout, *drying reddish brown*. **Inflorescences** *ramiflorus*, occasionally axillary, fascicled, paniculate with first order branching, 2–2.5 cm long, glabrous, lowest branch 3–6 mm long; peduncle 3–5 mm long; bracts scarious, ovate-acute, *c.* 4 mm long, glabrous, persistent. **Flowers** sessile, bisexual, pale green or white, sometimes tinged purple or creamy yellow with a brown centre; buds pointed; calyx *c.* 2.5 mm long, divided *c.* halfway, lobes acute, glabrous, margin sometimes ciliate; corolla *c.* 5 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens with broad filament *c.* 0.5 mm long, attached at base of corolla, anthers oblong, *c.* 0.5 mm long; ovary globose, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** 1.5–3.5 cm long, thickened. **Fruits** *ovoid*, *up to 2.5 × 2 cm*, *smooth*, *not curved*, base flattened, apex acute; pericarp purple, drying with white bloom, *c.* 1 mm thick, leathery; stalk 3–10 mm long. **Seeds** albuminous.

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo (Sabah and Kalimantan). In Sabah, not common, collected several times from Sandakan district and once from Tenom district (e.g., *SAN 35605*, *SAN 72028* and *SAN 79917*).

Ecology. Lowland mixed dipterocarp and swamp forests, commonly on hill slopes, at altitudes to 500 m.

4. **Chionanthus cordulatus** Koorders

(Latin, *cordulatus* = shallowly heart-shaped at base; referring to the leaf blade)

Meded's Lands Plant.19 (1898) 527 & 638. **Type:** *Koorders 19592*, Sulawesi, Minahasa, Menado (BO, L).

Small tree or shrub to 15 m tall and 30 cm diameter; once recorded as a climber (*Carr SFN 26728*). **Bark** greenish; inner bark pink-yellow. **Sapwood** yellowish. **Twigs** moderately slender, round in cross-section, drying white, nodes slightly flattened, lenticellate, glabrous. **Leaves** chartaceous, glabrous, drying green-brown to light chestnut-brown; slightly obovate to ovate, (16–)22(–36) × (6–)8(–13) cm, *base cordate*, margin not recurved, apex acuminate or sometimes acute, acumen to 1.5 cm long; midrib and lateral veins plane above, prominent beneath; lateral veins (9–)12(–17) pairs, marginal vein 2–3 mm from margin; petiole (0.4–)0.8(–1.5) cm long, thickened, drying white. **Inflorescences** ramiflorus or axillary, 3 or more fascicled together, racemose with 3–6 pairs of flowers or racemose panicle, 1–4 cm long, lowest branch to 1 cm long; flowers well spaced, pubescent; peduncle 3–5 mm long; bracts scarious, acute, 2–3 × 1.5 mm, densely pubescent, persistent. **Flowers** bisexual, white or yellowish green; buds pointed; pedicel 1–2 mm long; calyx *c.* 0.5 mm long, divided *c.* halfway, lobes acute, minutely pubescent; corolla 6–8 mm long, divided almost to base, lobes narrowly linear, straight or twisted at anthesis; stamens sessile, anther oblong, *c.* 0.7 mm long; ovary globose, *c.* 1 mm diameter, glabrous, stigma capitate. **Infructescences** thickened. **Fruits** ovoid, *c.* 2.75 × 2.25 cm, apex rounded; pericarp greyish green, rough with brown warts, *c.* 2 mm thick, leathery; stalk *c.* 5 mm long and 2 mm thick. **Seeds** albuminous.

Distribution. Borneo (Sabah and E Kalimantan), NE Sulawesi and N Maluku. In Sabah, known from Keningau, Ranau, Tambunan, and Tenom districts (e.g., *SAN 114151*, *SAN 116582*, *SAN 120257*, *SAN 122437*, and *SFN 26728*). In Kalimantan, recorded from Berau (e.g., *Kostermans 21416*).

Ecology. Lowland forest usually by rivers but also from hillsides, at altitudes to 930 m.

5. **Chionanthus crispus** Kiew

(Latin, *crispus* = curled; alluding the strongly twisted petals at anthesis)

Malay. For. 44 (1981) 153; Coode *et al.* (eds.) *l.c.* 247. **Type:** *Ahmad SAN 47649*, Borneo, Sabah, Lahad Datu district, Tabawan Is. (holotype SAN; isotypes KEP, L).

Tree to 30 m tall and 60 cm diameter; flowering at 3 m tall; bole shortly buttressed or fluted. **Bark** grey, smooth or lenticellate; inner bark orange. **Sapwood** ochre. **Twigs** slender, *round in cross-section*, drying white, nodes flattened, glabrous, lenticels inconspicuous. **Leaves** *coriaceous*, glabrous, *drying dull and plane above*, grey-green or sometimes brownish green beneath; *oblong-ovate*, occasionally rotund, 7–13 × 2.5–5.5 cm, *base rounded* or *cuneate*, margin slightly recurved, *apex cuspidate*, acumen 1–2 cm long; midrib plane or slightly impressed above, slightly prominent beneath; *lateral veins* 6–9 pairs, *plane and obscure on both surfaces*, marginal vein 1–2 mm from margin; *intercostal venation obscure*; *petiole* 0.5–0.7 cm long, not thickened, *drying black*, densely pubescent. **Inflorescences** axillary and solitary, *racemose* with 3–4 spaced pairs of opposite flowers, 0.5–1.5 cm long; peduncle *c.* 1 mm long, ferrugineous; bracts scarious, *c.* 2 mm long, pubescent, persistent. **Flowers** bisexual, white or purple; buds pointed; sessile or with pedicel to 1 mm long; calyx *c.* 2 mm long, divided almost to base, lobes acute, pubescent, margin ciliate; corolla 5–6 mm long, divided almost to base, lobes narrowly linear, strongly twisted and recurved at anthesis; stamens subsessile, attached at base of corolla, anthers oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Fruits** (?immature) ovoid, *1–1.2 × 0.8 cm*, *smooth*, *not curved*, apex rounded; pericarp drying thin and brittle. **Seeds** unknown.

Distribution. Endemic to Borneo (Sabah and Brunei only). In Sabah, known from islands in the south (Tabawan, Timbun Mata and Pababag Is.; e.g., *SAN 63917* and *SAN 68539*) and inland from ultrabasic soils at Lahad Datu district (Bt. Silam; e.g., *SAN 57285*), Ranau district (Bt. Hampuan; e.g., *SAN 56566* and *SAN 64136*) as well as from Sandakan district (Bt. Senilakan; e.g., *SAN 51240* and *SAN 53214*). In Brunei, recorded from Tutong district (e.g., *Coode 6854*).

Ecology. Primary forest, usually on sandy or ultrabasic soils, at altitudes to 850 m.

6. **Chionanthus curvicarpus** Kiew

(Latin, *curvi-* = curved, Greek, *karpos* = fruit; with curved fruits)

Gard. Bull. Sing. 37 (1984) 211; Coode *et al.* (eds.) *l.c.* 247; Argent *et al.* (eds.) *l.c.* 487. **Type:** *Aban SAN 35826*, Borneo, Sabah, Tawau district, Gading (holotype SAN; isotypes K, KEP, L). **Synonyms:** *Linociera cuspidata auct. non* (Blume) Knobl.: Merrill *l.c.* (1921) 488, *l.c.* (1929) 249, Masamune *l.c.* 612, Anderson *l.c.* 285; *Chionanthus cuspidatus auct. non* Blume: Kiew *l.c.* (1980) 372, *l.c.* (1981) 152.

Tree or shrub to 23 m tall and 30 cm diameter; bole to 10 m tall, occasionally fluted or with short buttresses. **Bark** smooth, whitish grey or brown; inner bark pale yellow. **Sapwood** whitish. **Twigs** moderately slender, *quadrangular in cross-section*, drying white, lenticels inconspicuous, nodes flattened, glabrous. **Leaves** chartaceous, glabrous, drying pale grey; oblong-lanceolate to narrowly lanceolate, 10–20(–28) × 3–8.5 cm, *base tapering* or *cuneate*, margin not recurved, apex acuminate or acute, acumen *c.* 1 cm long; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins (8–)10–11(–15) pairs, marginal vein 2–4 mm from margin; petiole 0.7–1 cm long, not thickened, drying brown. **Inflorescences** axillary, solitary or fascicled, shortly branched racemose panicle, 1–2.5(–6) cm long, branches 3–5(–11) mm long, glabrous; flowers distant; peduncle 3–5(–7) mm long; bracts scarious, ovate, *c.* 1 mm long, glabrous, persistent. **Flowers** bisexual, yellowish (sometimes yellowish green or greenish white); buds pointed; pedicel 1–2 mm long; calyx *c.* 1 mm long, divided more than halfway, lobes acute, sparsely pubescent, margin ciliate; corolla 2–4 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens subsessile, attached to base of corolla, anthers *c.* 1 mm long, oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, 2–3 cm long. **Fruits** ellipsoid, *c.* 2.5 × 1.7 cm, *curved and longitudinally ridged*, acutely narrowed to base, apex rounded and apiculate; pericarp smooth, green even when mature, drying *c.* 1 mm thick, leathery; stalk 4–8 mm long. **Seeds** albuminous.

Vernacular name. Sabah—*mak ulat* (Dusun-Kaingaran).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei, C and SE Kalimantan). In Sabah, common throughout (e.g., *SAN 24871*, *SAN 36484*, *SAN 56153*, *SAN 75309*, and *SAN 83970*). In Sarawak, occasional (G. Murut, G. Mulu, Kapit, and Kelabit Highlands; e.g., *Geh & Syamsuri 960*, *Nooteboom & Chai 1740*, *S 20212* and *S 48010*). In Brunei, recorded from Belalong and Temburong districts (e.g., *BRUN 997*, *Dransfield JD 7317* and *Wong WKM 1394*). Also occurs in E Kalimantan (e.g., *McDonald & Ismail 3621* and *Kostermans 10590*).

Ecology. Lowland primary or old secondary forest and riverine forest, usually at altitudes to 1000 m.

7. **Chionanthus evenius** (Stapf) Kiew

(Latin, *even* = even; referring to the leaf surface)

Malay. For. 42 (1979) 268, *l.c.* (1980) 374, *l.c.* (1981) 159, *l.c.* (1989) 288; Coode *et al.* (eds.) *l.c.* 247. **Basionym:** *Linociera evenia* Stapf, Kew Bull. (1915) 116, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612, Anderson *l.c.* 285. **Type:** *Beccari PB 3301*, Borneo, Sarawak (holotype K).

Tree to 50 m tall and 30 cm diameter; bole shortly buttressed. **Bark** grey and smooth, falling in small, thin flakes; inner bark granular, sticky, yellow-brown. **Sapwood** white or pale pink. **Twigs** stout, *round in cross-section*, drying pale grey, nodes flattened, glabrous, lenticels conspicuous. **Leaves** *thickly coriaceous*, glabrous, drying grey above, orange and *rugose beneath*; *obovate* to *oblong-lanceolate*, 8–18(–28) × 4–5.5(–7) cm, *base strongly tapering*, margin recurved, apex acute to apiculate; midrib slightly impressed above; *lateral veins* 8–12 pairs, plane above, *obscure beneath*, marginal vein obscure; *petiole 1–2.5(–5) cm long*, slightly thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with distantly spaced short branches, *2.5–11 cm long*, lowest branch 0.75–1.5(–3) cm long; flowers in clusters of 5–8 at tips of branches, pubescent; peduncle slender, 1.5–3.5 cm long; bracts foliaceous, spathulate, to 5 mm long, sparsely pubescent, persistent. **Flowers** sessile, bisexual, pinkish white, buds pointed; calyx *c.* 1 mm long, divided to base, lobes acute, densely pubescent; corolla *c.* 3 mm long, divided almost to base, lobes narrowly linear, more or less straight at anthesis; stamens with filament *c.* 0.5 mm long, attached at base of corolla, anthers *c.* 1 mm long, oblong, connective apiculate; ovary ovoid, *c.* 1 mm long, glabrous, stigma slightly bilobed. **Infructescences** thickened, 5–14 cm long. **Fruits** *narrowly ellipsoid*, *3.5–4.5 × 2–2.5 cm*, *smooth*, *not curved*, apex narrowed, base rounded, creamy or light brown on drying; epicarp *c.* 1 mm thick; mesocarp 2–3 mm thick and leathery; endocarp *c.* 2 mm thick and woody; stalk enlarged, *c.* 5 mm long and 4 mm thick. **Seeds** albuminous.

Vernacular name. Sarawak—*sapah hutan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei, and Kalimantan). In Sabah, known only from Beaufort district (e.g., *SAN 80319*). In Sarawak, recorded from G. Penrissen, Setapok FR, Baram and Kayangeran (e.g., *Egon 340*, *Jacobs 5015*, *S 2887*, *S 4914*, and *S 30580*). In Brunei, known from Belalong area (e.g., *Coode 6479* and *S 5888*), and in Kalimantan from W Kutei.

Ecology. Freshwater or peat swamp forest in lowlands, once reported from mossy forest at *c.* 1400 m altitude (G. Penrissen).

8. **Chionanthus globosus** (Kiew) Kiew

(Latin, *globosus* = spherical; referring to the fruit)

TFSS 4, App. (2002) 352. **Basionym:** *C. elaeocarpus* (Stapf) Kiew var. *globosus* Kiew *l.c.* (1980) 374, *l.c.* (1981) 150. **Type:** *Chai S 35338*, Borneo, Sarawak, Kelabit Highlands (holotype SAR; isotype K).

Tree, 20–42 m tall, to 60 cm diameter; bole smooth, sometimes with buttresses 1.5–5 m tall. **Bark** almost smooth. **Sapwood** cream. **Twigs** stout, *round in cross-section*, drying blackish, ultimate twigs flattened, glabrous, lenticellate. **Leaves** *thickly coriaceous*, glabrous, drying dull, dark green-brown above, fawn and *smooth beneath* with lateral veins darker than leaf blade; *obovate*, 10–17 × 5–8 cm, *base strongly tapering*, margin strongly recurved, apex acute or with short acumen *c.* 3 mm long; midrib slightly raised above and prominent beneath; *lateral veins* 7–12 pairs, plane above, *prominent beneath*, marginal vein obscure; *petiole 2.5–3.5 cm long*, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with third to fourth order branching, *1–9 cm long*; rachis strongly flattened, lowest branch 1–2 cm long; flowers crowded at tips of branches, glabrous; peduncle stout, 1–6 cm long; bracts foliaceous, spathulate, 4–15 × 6 mm, pubescent, persistent. **Flowers** sessile, bisexual, white; buds pointed; calyx divided *c.* halfway, *c.* 1 mm long, lobes acute, pubescent; corolla divided almost to base, *c.* 4 mm long, lobes oblong, more or less straight at anthesis; stamens sessile, epipetalous, anthers yellow, *c.* 1 mm long, oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, to 11 cm long, bearing 1–3 fruits. **Fruits** *globose*, to *2–2.5 cm diameter*, *smooth*, *not curved*, green drying black; pericarp 3–5 mm thick, leathery; stalk *c.* 5 mm long. **Seeds** albuminous.

Distribution. Endemic to Borneo. Known from Sipitang district in Sabah (e.g., *SAN 16715* and *SAN 16745*), Belaga, Kapit, Lawas, Limbang, and Marudi districts in Sarawak (e.g., *S 26013*, *S 32225*, *S 34818*, *S 35338*, and *Zainuddin et al. AZ 5616*), and W Kutei in CE Kalimantan (e.g., *Endert 3134*, *Endert 3634*, *Endert 4308*, and *Endert 4436*).

Ecology. Usually in forest on mountain ridges, occasionally in *kerangas* forest, at 200–1300 m altitude.

Notes. Pickles (*S 3592*) records the fruits as edible.

9. **Chionanthus havilandii** Kiew

(J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Malay. For. 43 (1980) 375. **Type:** *Haviland 1873*, Borneo, Sarawak, Rejang (holotype SAR; isotype SING).

Tree to 20 m and 35 cm diameter, flowering at *c.* 2 m tall. **Bark** smooth, whitish. **Twigs** white, slender, *round in cross-section*, glabrous, slightly flattened at nodes, lenticellate. **Leaves** *coriaceous*, glabrous, *dull and plane above*, reddish brown beneath; broadly lanceolate to oblong, 5.5–10 × 3–7 cm, *base rounded* sometimes *cuneate*, margin finely recurved, *apex bluntly rounded into an acumen c. 1 cm long*; midrib slightly impressed above, prominent beneath; lateral veins 6–8 pairs, plane and obscure above, concolorous with leaf blade and slightly prominent beneath, marginal vein 2–4 mm from margin; *intercostal venation obscure*; *petiole* 0.5–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, 1–3 per axil, *racemose*, unbranched, with 3–4 pairs of opposite flowers, 1–1.5(–3) cm long; peduncle 2–3 mm long, glabrous; bracts scarious, ovate, 1–1.5 mm long. **Flowers** bisexual, yellow or white, somewhat fragrant; pedicel 1–1.5 mm long; calyx *c.* 1.5 mm long, shallowly lobed, lobes ovate, glabrous; corolla 5–5.5 mm long, free to base, lobes oblong-linear, induplicate, straight at anthesis; stamens with filament *c.* 0.5 mm long, anther oblong, *c.* 1 mm long; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Fruits** ovoid, *c. 2.5 × 1.75 cm*, *not curved*, *longitudinally ridged*, green drying light brown; pericarp leathery, 2–3 mm thick when dry; endocarp brittle. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Sarawak (e.g., *Egon A 837*, *Haviland 894*, *Haviland 1754*, *Haviland 3041*, *Haviland 1873*, *S 140*, *S 9042*, and *S 34210*).

Ecology. In swamp and *kerangas* forest, besides streams.

10. **Chionanthus kinabaluensis** Kiew

(of G. Kinabalu, Sabah)

TFSS 4, App. (2002) 352. **Type:** *Clemens 29348–30229* (p. 0189 Oleaceae), Borneo, Sabah, Tenompok, G. Kinabalu (holotype SING; isotype SING).

Tree. **Twigs** slender, *round in cross-section*, glabrous, strongly flattened at nodes, drying brown, lenticels conspicuous. **Leaves** *coriaceous*, glabrous, drying *dull pale brown* and *plane above*, paler chestnut-brown beneath, with midrib, lateral and intercostal veins darker; lanceolate, 9.5–12 × 3.5–5.25 cm, *base cuneate*, margin finely recurved, apex cuspidate, acumen to 1.25 cm long; midrib slightly raised above, plane beneath; lateral veins 7–9 pairs, plane and obscure above, slightly prominent beneath, *intercostal venation reticulate*, *conspicuous and darker than leaf blade beneath*, marginal vein 1–2 mm from margin; *petiole* 0.8–1 cm long, not thickened, *drying black*. **Inflorescences** and **flowers** unknown. **Infructescences** axillary, solitary, glabrous, *racemose*, 2–3.5 cm long; peduncle 0.4–1 cm long; pedicel *c.* 4 mm long, thickened. **Fruits** slightly obovoid, 1.4–1.5 × 1–1.3 cm, *smooth*, *not curved*, (?immature) green with purple cheeks; pericarp *c.* 1 mm thick; endocarp woody. **Seeds** unknown.

Distribution. Endemic to Borneo and known only from G. Kinabalu in Sabah (e.g., *Clemens 29348–30229*).

Ecology. Montane forest.

11. **Chionanthus leopoldi** Kiew Fig. 2.

(Leopold Madani, senior research assistant, Sandakan Herbarium)

TFSS 4, App. (2002) 353. **Type:** *Leopold & Taha SAN 83546*, Borneo, Sabah, Mile 87.5 Telupid Road (holotype SAN; isotypes K, KEP, L, SAR, SING).

Small tree to 13 m tall and 30 cm diameter; bole to 10 m tall. **Bark** greyish, lenticellate; inner bark dark brown. **Sapwood** reddish or pale green. **Twigs** moderately stout, *round in cross-section*, glabrous, lenticellate, nodes slightly flattened, drying whitish. **Leaves** *thickly coriaceous*, glabrous, dull olive-brown above, rich chestnut-brown beneath with veins slightly paler than leaf blade; *broadly elliptic*, (*14–*)*21*(*–24*) × (*6.5–*)*7.5*(*–9*) *cm*, *base rounded* sometimes slightly unequal, margin recurved, apex acuminate, acumen (1–)2.5 cm long; midrib slightly raised above, plane beneath; *lateral veins 7*(*–8*) *pairs*, *plane and obscure above*, plane or slightly prominent beneath, marginal vein 2–5 mm from margin; intercostal venation usually obscure; *petiole 1.5–2 cm long*, slightly thickened, *drying black* and wrinkled transversely. **Inflorescences** axillary, *panicle with first order branching*, solitary, *c. 3.5 cm long*, with *c.* 4 *regularly spaced sparsely pubescent flowers*, lowest branch 1–1.25 cm long, glabrous; peduncle 0.5–1 cm long; bracts linear 1–3 mm long, pubescent, persistent. **Flowers** bisexual, pale greenish; pedicel 1–3 mm long; calyx *c.* 1 mm long, divided less than halfway, very sparsely pubescent, lobes acute, margin slightly ciliate; corolla 3–4 mm long, glabrous, lobes narrowly linear, scarcely joined in pairs at base, margin involute, apex acute, more or less straight at anthesis; stamens sessile attached at base of corolla, anther subglobose, *c.* 0.6 mm long, connective not apiculate; ovary narrowly ovoid, *c.* 1 mm long, glabrous, stigma slightly bilobed. **Infructescences** 2–6 cm long, slightly thickened. **Fruits** *globose*, *1.6–1.8 cm diameter*, *smooth*, *not curved*, ripening purple with white spots or red-brown; pericarp *c.* 0.75 mm thick; endocarp thin and brittle. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Kinabatangan and Labuk Sugut districts in Sabah (e.g., *SAN 83544*, *SAN 85682*, *SAN 93967*, *SAN 125946*, and *SAN 133958*).

Ecology. In mixed dipterocarp forest on hill slopes or ridges, at 100–700 m altitude.

12. **Chionanthus lucens** Kiew

(Latin, *lucens* = polished; referring to the leaf surface)

Malay. For. 44 (1981) 154. **Type:** *Mujing SAN 40652*, Borneo, Sabah, Tawau (holotype SAN; isotypes KEP, L).

Tree, 9–18 m tall, to 25 cm diameter. **Bark** whitish, lenticellate to scaly; inner bark yellow or reddish. **Sapwood** yellowish, pale reddish or greyish. **Twigs** moderately slender, *round in cross-section*, white to pale grey-brown, nodes slightly flattened, lenticels inconspicuous, glabrous. **Leaves** *subcoriaceous*, sparsely pubescent to glabrous, drying greyish brown, *wrinkled and conspicuously glossy above*; *oblong* or broadly elliptic, (9–)11.5–15.5(–18.5) × (2.75–)5–6.5 cm, *base rounded* and decurrent, margin slightly recurved, apex cuspidate, acumen to 1.5 cm long;

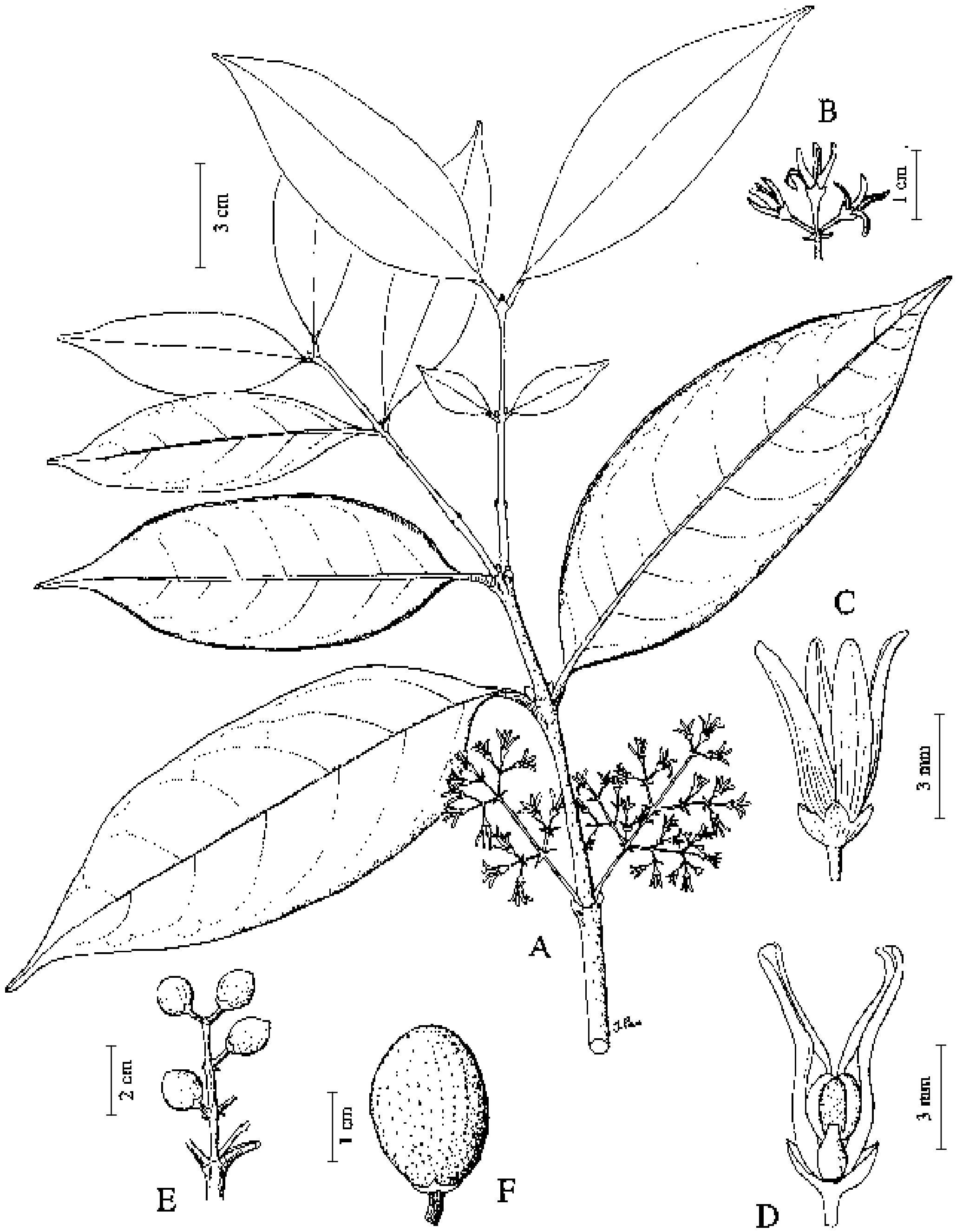

Fig. 2. *Chionanthus leopoldi*. A, flowering leafy twig; B, distal portion of inflorescence; C, open flower; D, open flower with two calyx lobes, two corolla lobes and one stamen removed; E, infructescence; F, fruit. (A–D from *SAN 125946*, E–F from *SAN 85682*.)

midrib slightly impressed above, plane beneath; lateral veins 5–7(–9) pairs, slightly impressed above, plane beneath, marginal vein (2–)3–5 mm from margin; *petiole* 0.5–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *racemose* with pairs of opposite flowers or *once branched panicle*, (0.75–)2–2.5 cm long, lowest branch 4–5 mm long; flowers spaced, finely pubescent; peduncle *c.* 5 mm long; bracts foliaceous, spathulate, 1–4 mm long, pubescent, persistent. **Flowers** *bisexual*, light green or yellow; buds pointed; pedicel 1–2 mm long; calyx *c.* 1 mm long, divided almost to base, lobes acute, finely pubescent or glabrous; corolla *c.* 2 mm long, divided to base, lobes narrowly linear, straight, glabrous; stamens sessile, inserted at base of corolla tube, anthers oblong, less 1 mm long; ovary conical, *c.* 1 mm long, stigma sessile, bilobed. **Infructescences** thickened, 1.5–2.5 cm long. **Fruits** ovoid, 1.2–1.5 × 0.9 cm, *smooth*, *not curved*, apex pointed; stalk 3–7 mm long, *c.* 2 mm thick; endocarp *c.* 1 mm thick, brittle. **Seeds** albuminous.

Vernacular name. Sarawak—*bokol* (Land Dayak).

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak and E Kalimantan). In Sabah, known from Tawau district (e.g., *SAN 32997*, *SAN 40652* and *SAN 134079*). In Sarawak, recorded from Bau and Bintulu districts (e.g., *S 24551*, *S 47578*, *S 48202*, and *S 50174*). In Kalimantan, known from Balikpapan area (e.g., *Ambri & Arifin AA 78*) and E Kutei (e.g., *Leighton s.n.*).

Ecology. Rare, in primary and secondary mixed dipterocarp forest on flatland or hillsides, at altitudes to 750 m.

13. **Chionanthus macrocarpus** Blume

(Greek, *makro* = large, *karpos* = fruit; with large fruits)

Mus. Bot. Lugd. Bat. 1 (1850) 319; Kiew, Gard. Bull. Sing. 37 (1984) 209. **Lectotype** (Kiew, 1984)**:** *Blume s.n.* (= *RHL Sheet No. 908161219*), Java (hololectotype L). **Synonyms:** *Chionanthus insignis* Miq., Fl. Ind. Bat. Suppl. (1862) 559; *Linociera macrocarpa* (Blume) Knobl., Bot. Centralbl. 61 (1895) 87, King & Gamble *l.c.* 267, Backer & Bakhuizen *f.*, FJ 2 (1965) 214, Anderson *l.c.* 285; *L. elaeocarpa* Stapf *l.c.* 115, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612; *C. elaeocarpus* (Stapf) Kiew, Malay. For. 42 (1979) 267, *l.c.* (1980) 373, exclusive var. *globosus* Kiew, *l.c.* (1981) 150, exclusive var. *globosus* Kiew.

Tree, 10–30 m tall, to 60 cm diameter; bole smooth or sometimes with buttresses to 2 m high. **Bark** almost smooth. **Sapwood** white. **Twigs** stout, *round in cross-section*, drying grey-brown or white, nodes strongly flattened, glabrous, lenticellate. **Leaves** *coriaceous* sometimes *subcoriaceous*, glabrous, drying dull reddish or dark brown on both surfaces, lateral veins darker than leaf blade beneath; *obovate*, 15–30 × 5–10 cm, *base tapering*, margin recurved, apex acute (sometimes with an acumen to 7 mm long); midrib plane above and prominent beneath; lateral veins 11–19 pairs, plane or sometimes impressed above, slightly prominent beneath, marginal vein obscure; *intercostal venation obscure*; *petiole 1.5–3 cm long*, slightly thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with third to fourth order branching, 5–11 cm long, lowest branch 1–2 cm long; flowers crowded at tips of branches, glabrous; *peduncle* stout, *less than half the length of inflorescence*, slightly flattened; bracts foliaceous, spathulate, 6–15 × 4–6 mm, pubescent, persistent. **Flowers** sessile, bisexual, white; *buds pointed*; calyx *c.* 1 mm long, divided *c.* halfway, lobes acute, pubescent; corolla divided almost to base, 3–4 mm long, lobes oblong, more or less straight at anthesis; stamens sessile, epipetalous, anthers yellow, *c.* 1 mm long, oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, *c.* 12 cm long, bearing 1–3 fruits. **Fruits** oblong-ellipsoid, to *4.5 × 2.5 cm*, *smooth* (sometimes slightly angled), *not curved*, base rounded, bluish green when fresh, drying brick red to brownish yellow to golden brown sometimes with glaucous bloom; *pericarp 3–5 mm thick*, leathery; stalk thickened, 10–15 mm long, *c.* 6 mm thick. **Seeds** albuminous.

Vernacular names. Sarawak—*kayu bura* (Kelabit), *kerdam* (Melanau).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak and Kalimantan), and Java. In Sabah, known from G. Kinabalu (e.g., *Carr SFN 20789*). In Sarawak, recorded from Kuching district (e.g., *Haviland 2298* and *Omar 351*). Also occurs in Kalimantan (e.g., *Kostermans 7561* and *Kostermans 7569*).

Ecology. Lowland to hill primary mixed dipterocarp forest, at altitudes to 1700 m.

14. **Chionanthus pachyphyllus** (Merr.) Kiew

(Greek, *pachy-* = thick, *phullon* = leaf; with thick leaf)

Malay. For. 43 (1980) 381; Coode *et al.* (eds.) *l.c.* 247. **Basionym:** *Linociera pachyphylla* Merr., J. Arn. Arb. 35 (1954) 150. **Type:** *Native Collector 584*, Borneo, Sarawak, without locality (holotype K; isotype L).

Tree or shrub to 22 m tall and 20 cm diameter. **Bark** light brown, smooth; inner bark brown. **Sapwood** brown or yellow. **Twigs** stout, *round in cross-section*, drying grey or light reddish brown, nodes stongly flattened and bearing large and conspicuous horseshoe-shaped leaf scars, subpubescent or glabrous. **Leaves** *thickly coriaceous*, glabrous, minutely punctate beneath, drying chesnut-brown or greenish brown and slightly glossy above and chesnut-brown beneath; *broadly elliptic*, sometimes *narrowly lanceolate*, (*16–*)*21–24*(*–30*) × *5.5–9*(*–13*) *cm*, *base rounded* sometimes *cuneate*, apex acuminate or acute, acumen to 1.5 cm long, margin slightly recurved; midrib plane above, prominent beneath; *lateral veins* (*8–*)*10–12*(*–14*) *pairs*, *deeply impressed above*, prominent beneath, marginal vein 1–2 mm from margin; *petiole 1–2 cm long*, stout, thickened, *drying black*. **Inflorescences** axillary, solitary or fascicled, *panicle with second order branching*, in bud 1–2.5 cm long, *in flower 3–7 cm long*, lowest branch c. 3 cm long; *flowers spaced*, *sparsely pubescent*; peduncle *c.* 0.5 cm long; bracts scarious, ovate, *c.* 3 mm long, tomentose, caducous. **Flowers** bisexual, yellow; pedicel to 1 mm long; buds pointed; calyx *c.* 1.5 mm long, divided halfway, lobes acute, more or less glabrous; corolla 4–5 mm long, divided to base except where joined in pairs for *c.* 1 mm, fleshy, lobes narrowly linear, twisted at anthesis; stamens inserted at base of corolla, filament *c.* 0.5 mm long, anthers *c.* 1 mm long, oblong, white; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, to 7 cm long. **Fruits** *globose*, *c. 1.5 cm diameter*, *smooth*, *not curved*, apex rounded; pericarp brownish green, ripening dark purple, drying *c.* 0.5 mm thick, leathery; stalk *c.* 5 mm long and 3 mm thick. **Seeds** albuminous.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei). In Sabah, recorded from Kota Belud (G. Kinabalu), Sandakan and Sipitang districts (e.g., *SAN 83645*). In Sarawak, known

from Kuching (G. Penrissen), Lawas, Limbang, and Marudi (G. Mulu) districts (e.g., *S 32870*, *S 40746* and *S 47687*). In Brunei, recorded from Temburong district (e.g., *Coode 6620*).
Ecology. In hill mixed dipterocarp to lower montane forest on sandstone, and in *kerangas* forest, at altitudes to 1500 m.

15. **Chionanthus palustris** Kiew

(Latin, *palustris* = swampy; referring to the natural habitat of the species)

Malay. For. 43 (1980) 382. **Type:** *Anderson S 3282*, Borneo, Sarawak, Baram (holotype SAR).

Shrub or tree, 3–17 m tall, to 15 cm diameter; bole with small stilt roots to 1 m tall. **Bark** light brown, smooth or rough and scaly. **Twigs** moderately slender, *round in cross-section*, drying dark grey, nodes flattened, lenticels inconspicuous, glabrous. **Leaves** *thickly coriaceous*, glabrous, drying pale greenish or reddish brown on both surfaces; broadly elliptic to lanceolate, 7–14 × 3–6.5 cm, *base abruptly rounded* or *cuneate*, margin not recurved, apex abruptly caudate, acumen to 2 cm long; midrib impressed above and plane beneath; lateral veins 6–10 pairs, obscure and plane above, slightly impressed beneath, marginal vein 2–3 mm from margin; *petiole 0.5–0.7 cm long*, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, solitary, *condensed raceme* with 2–3 pairs of flowers, *c. 0.5 cm long*; peduncle *c.* 2 mm long; flowers crowded, sparsely pubescent; bracts scarious, ovate, *c.* 2 mm long, pubescent. **Flowers** bisexual, yellowish green; buds pointed; pedicel to 1 mm long, uppermost flowers sessile; calyx *c.* 1 mm, divided almost halfway, lobes acute, sparsely pubescent; corolla *c.* 6 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens sessile, joined at base of corolla, anthers *c.* 1 mm long, broadly oblong; ovary ovoid, *c.* 1.5 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 1 cm long. **Fruits** globose, 1.5–2 cm diameter, *smooth*, *not curved*, apex rounded; pericarp cream-coloured, drying thin and brittle, *c.* 1 mm thick. **Seeds** albuminous.

Vernacular name. Sarawak—*ubah mata* (Malay).

Distribution. Endemic to Borneo (Sarawak and Brunei). In Sarawak, known from Kuching, Lawas, Marudi, and Sarikei districts (e.g., *Haviland 2167*, *S 26622*, *S 26779*, *S 27834*, and *S 30703*). In Brunei, recorded from Andulau and Badas FR (e.g., *S 1059*, *S 2041* and *Sands 5929*).

Ecology. Lowland peat swamp, mixed swamp, *kerangas* and *alan* forests.

16. **Chionanthus plurifloroides** Kiew

(Latin, -*oides* = resembling; resembling *C. pluriflorus*)

TFSS 4, App. (2002) 353. **Type:** *Kulip & Goh SAN 137038*, Borneo, Sabah, Kinabatangan district, Tongod, G. Tingkar Waterfall (holotype SAN; isotype KEP).

Small tree to 17 m and 30 cm diameter; bole to 10 m tall, sometimes with buttresses *c.* 1 m high. **Bark** yellowish grey or dark brown, pustulate or smooth, *c.* 2 mm thick. **Sapwood** white. **Twigs** slender, *round in cross-section*, drying pale brown, lenticels not conspicuous; young twigs, petiole and bracteoles minutely rusty pubescent. **Leaves** *subcoriaceous* to *characteous*, *dull and plane above*, *drying dark chestnut-brown on both surfaces with lateral veins darker than leaf blade beneath*; *oblong* to *lanceolate*, (12–)17(–20) × (4.25–)5.5(–6.75) cm, *widest at the middle*, *base rounded*, sometimes slightly cuneate, margin not recurved, *apex acuminate* to *cuspidate*, acumen to 1 cm long; midrib and veins plane above, prominent beneath; lateral veins (7–)8(–11) pairs, marginal vein 2–3 mm from margin; intercostal venation obscure; *petiole* (0.7–)0.8(–1.4) cm long, slightly thickened, *drying black*. **Inflorescences** axillary, *panicle of cymes with first order branching at base* and 3–4 regularly spaced pairs of flowers above, 2–4 cm long, lowest branch *c.* 1.5 cm long; peduncle 3–4 mm long; bracteoles scarious, 1–2 mm long, persistent. **Flowers** *bisexual*, yellow-green; pedicel to 1 mm long; calyx *c.* 1 mm long, divided almost to base, lobes acute, glabrous with sparsely ciliate margin; corolla *c.* 4 mm long, glabrous, narrowly linear, margin involute, apex acute, scarcely joined in pairs at base, twisted at anthesis to expose stamens; anthers sessile, joined at base of corolla, ellipsoid, *c.* 1 × 0.4 mm, connective slightly apiculate; ovary globose, *c.* 1.25 mm long, glabrous, stigma slightly bilobed. **Infructescences** thickened. **Fruits** globose, *c. 1.5 × 1.4 cm*, *smooth*, *not curved*, blue green; pericarp *c.* 2 mm thick; endocarp woody, *c.* 1 mm thick; stalk thickened. **Seeds** endospermous.

Vernacular name. Sabah and Sarawak—*obah putih* (Malay).

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan). In Sabah, common in the southern half (e.g., *Elmer 20332*, *SAN A 2064*, *SAN 16828*, *SAN 66094*, *SAN 81412*, and *SAN 124515*). In Sarawak, known from G. Lesong (e.g., *S 43242*). In Kalimantan, recorded from G. Tepian Lobang (e.g., *Kostermans 5321*).

Ecology. Mixed dipterocarp forest, at altitudes to 600 m. In Kalimantan occur on coral limestone.

17. **Chionanthus pluriflorus** (Knobl.) Kiew Fig. 3.

(Latin, *pluri-* = many, *florus* = flower; referring to the many-flowered inflorescence)

Malay. For. 43 (1980) 384, *l.c.* (1981) 151; Kessler & Sidiyasa, TBSA-EK (1994) 188; Coode *et al.* (eds.) *l.c.* 247; Argent *et al.* (eds.) *l.c.* 481. **Basionym:** *Linociera pluriflora* Knobl. *l.c.* 130, Merrill *l.c.* (1921) 489, Fisher, Kew Bull. (1933) 181, Masamune *l.c.* 612, Anderson *l.c.* 285. **Type:** *Beccari PB 915*, Borneo, Sarawak (holotype K). **Synonym:** *Linociera verruculosa* Merr., Philip. J. Sci. Bot. 13 (1913) 119, *l.c.* (1921) 489, Masamune *l.c.* 489.

Tree, 10–25(–60) m tall, to 60 cm diameter, flowering at *c.* 3 m tall; bole occasionally with short buttresses or stilt roots. **Bark** smooth, greenish; inner bark yellow. **Sapwood** white. **Twigs** moderately stout, *round in cross-section*, white, grey or pale brown, nodes strongly flattened, lenticels inconspicuous, glabrous or sparsely pubescent. **Leaves** *chartaceous* sometimes *subcoriaceous*, glabrous or rarely densely pubescent, *drying* dull grey-green and plane above, *chestnut-brown* with lateral veins darker than leaf blade *beneath*; *lanceolate* sometimes broadly so, (12–)15–20(–30) × 4.5–6.5(–9.5) cm, *base cuneate*, margin not recurved, apex acuminate or acute; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins 7–14

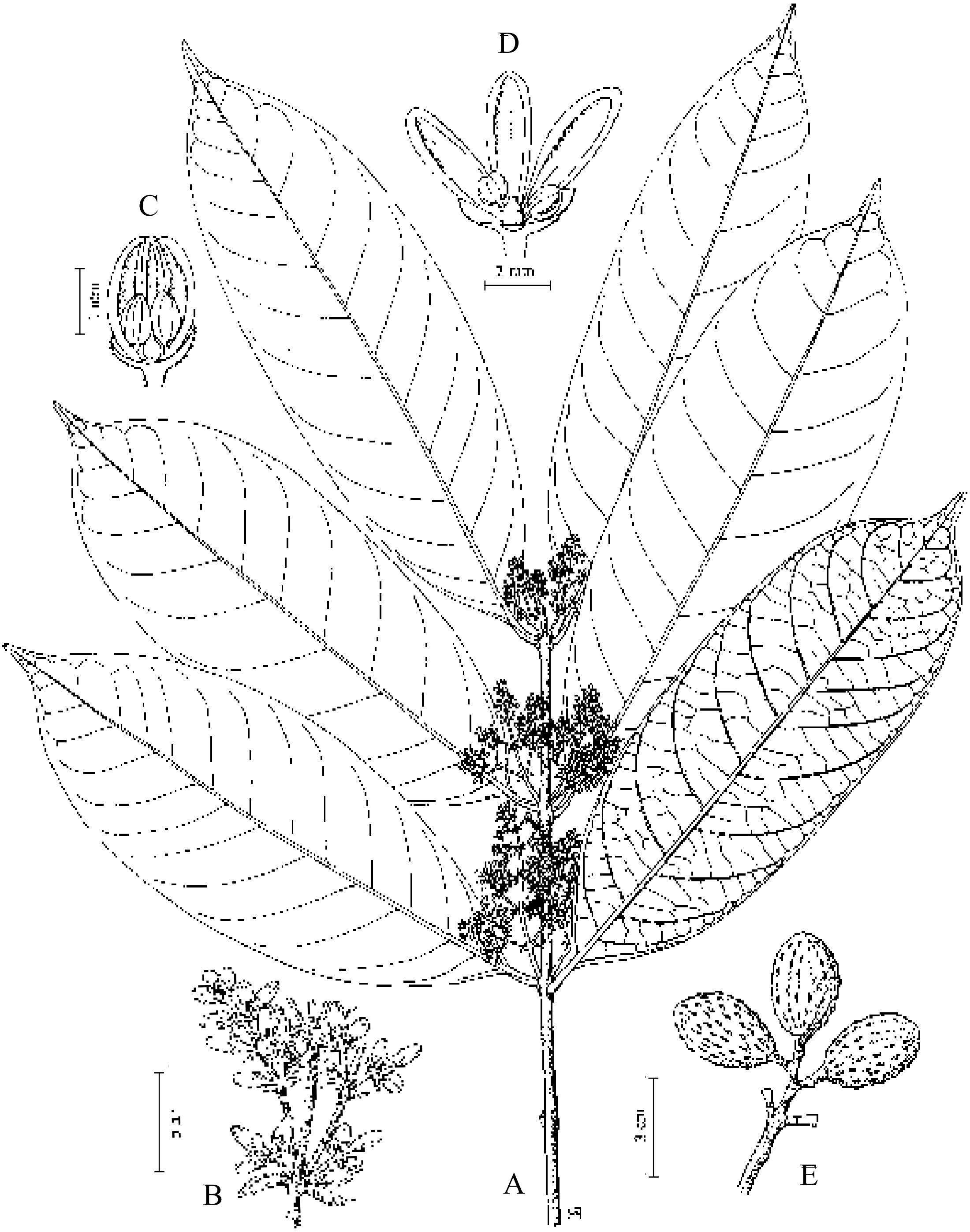

Fig. 3. *Chionanthus pluriflorus*. A, flowering leafy twig; B, part of inflorescence; C, longitudinal section of flower bud with two calyx lobes and one corolla lobe removed; D, longitudinal section of open flower with two calyx lobes and one corolla lobe removed; E, infructescence. (A–D from *SAN 32274*, E from *S 31147*.)

pairs, marginal vein 1–2 mm from margin; *petiole 0.5–1.5 cm long*, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, often fascicled, *panicle with second order branching*, 4.5–7(–21) cm long, with 3–4 branches, lowest branch 2–5.5 cm long; *flowers crowded at tips of branches*, pubescent; peduncle 0.5–2 cm long; bracts foliaceous, spathulate, *c.* 8 × 2 mm long, minutely pubescent. **Flowers** *bisexual*, subsessile or with pedicel to 1 mm long, yellow or yellowish green; *buds pointed*; faintly fragrant; calyx *c.* 1 mm long, divided *c.* halfway, lobes acute, pubescent, margin ciliate; corolla 3–3.5 mm long, divided almost to base, lobes narrowly linear, fleshy, more or less straight at anthesis; stamens filaments *c.* 0.3 mm long, joined at base of corolla, anthers less than 1 mm long, broadly oblong; ovary ovoid, less 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 10.5 cm long. **Fruits** ellipsoid, to 2.6 × 1.9 cm, *not curved*, apex rounded, *prominently pimply* (*verrucose*), green (even when ripe); *pericarp drying c. 2 mm thick*; endocarp *c.* 1 mm thick and woody; stalk to 7 mm long, *c.* 4 mm thick. **Seeds** albuminous.

Vernacular names. Sarawak—*bekeraiah* (Kayan), *bukar* (Murut), *kuku mendo*, *mok*, *muak* (Iban).

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei). In Sabah, common and widespread (e.g., *SAN 39899*, *SAN 55806*, *SAN 60180*, *SAN 68361*, and *SAN 117569*). In Sarawak, recorded from Bintulu, Kuching, Lawas, Marudi, and Sibu districts (e.g., *Beccari PB 915*, *Haviland 3038*, *S 16294*, *S 31147*, *S 35772*, and *S 50432*). In Brunei, known from Belait and Tutong districts (e.g., *BRUN 5640* and *Coode 6366*).

Ecology. Primary lowland and hill mixed dipterocarp forest, frequently on river banks or in swamp forest, from sea level to 1500 m.

Uses. The green fruit is reported as edible by the Murut.

18. **Chionanthus polycephalus** Kiew

(Greek, *poly-* = many, *cephalus* = head; referring to the tight balls of flowers on the inflorescence branches)

Malay. For. 43 (1980) 386. **Type:** *Anderson & Chai S 32158*, Borneo, Sarawak, Bau district, Bt. Jebong (holotype SAR; isotypes L, SING).

Tree to 20 m tall and 25 cm diameter. **Bark** dark grey, rough and slightly fissured. **Twigs** moderately stout, *round in cross-section*, drying dark grey, nodes flattened with prominent horseshoe-shaped leaf scars, lenticellate, glabrous. **Leaves** *thickly coriaceous*, glabrous, drying reddish brown and sometimes slightly glossy above; *lanceolate*, *9–14 × 3–6 cm*, *base rounded*, margin sometimes recurved, apex acuminate, acumen to 1 cm long; midrib slightly impressed above and plane beneath; lateral veins 8–15 pairs, plane above, obscure beneath; *petiole 1–1.5 cm long*, not thickened, *drying* wrinkled and *black*. **Inflorescences** axillary or extra-axillary, solitary, *paniculate*, *2.5–4 cm long*, first order branches 0.5–1 cm long terminating in *tight clusters of 3–10 flowers*, *densely rusty brown hairy*; peduncle *c.* 5 mm long; bracts foliaceous, thick, *c.* 6 × 2 mm, densely pubescent, persistent. **Flowers** sessile, bisexual, creamy-white; buds pointed; calyx *c.* 2 mm long, with fleshy base, divided *c.* halfway, lobes acute, densely pubescent; corolla *c.* 5 mm long, divided almost to base, lobes narrowly linear, joined in pairs for *c.* 1 mm, twisted at anthesis; stamens sessile, anthers oblong, *c.* 1 mm long; ovary narrowly ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, *c.* 2 cm long. **Fruits** *ovoid*, *c. 2.5 × 1.7 cm*, *smooth*, *not curved*, apex apiculate; pericarp yellowish, drying *c.* 1 mm thick, leathery; stalk swollen, 7–9 mm long, *c.* 3 mm thick. **Seeds** albuminous.

Distribution. Endemic to Borneo. Known only in Sarawak from Kuching district (e.g., *Haviland s.n.*) and Bt. Bidi and Bt. Jebat in Bau district (e.g., *S 32158*).

Ecology. Confined to limestone hill forest.

19. **Chionanthus polygamus** (Roxb.) Kiew Fig. 4.

(Latin, *polygamus* = having both unisexual and bisexual flowers)

TFSS 4, App. (2002) 354. **Basionym:** *Samara polygama* Roxb., Fl. Ind. 1 (1820) 435, *ibid.* 2nd. edition 1 (1832) 414. **Type:** *Roxburgh 2603*, Maluku (BM). **Synonyms:** *Ardisia polygama* (Roxb.) A.DC, Prod. 8 (1844) 138; *Linociera polygama* (Roxb.) S.Moore, J. Bot. (London) 51 (1913) 216; *Chionanthus laxiflorus* Blume *l.c.* 319, Kiew, Malay. For. 42 (1979) 270, *l.c.* (1980) 377, *l.c.* (1981) 151, *l.c.* (1989) 287, Coode *et al.* (eds.) *l.c.* 247, Argent *et al.* (eds.) *l.c.* 489; *L. laxiflora* (Blume) Knobl. *l.c.* 87, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612, Anderson *l.c.* 285.

Tree, *12–20(–30) m tall*, to 40 cm diameter; flowering at *c.* 4 m tall; bole rarely buttressed. **Bark** grey; inner bark orange-brown. **Sapwood** white or pale ochre. **Twigs** slender, *round in cross-section*, drying pale grey, nodes flattened, glabrous, lenticellate. **Leaves** *coriaceous*, glabrous, drying slightly glossy and greyish green sometimes brownish above; *lanceolate* (to slightly obovate), (5–)8–12(–17) × 1.5–6.5 cm, *base cuneate* or *slightly rounded*, margin not recurved, apex acuminate to cuspidate, acumen to 1.5 cm long, rarely apiculate; midrib and veins plane above, obscure or puckering along veins on drying; midrib slightly prominent beneath; lateral veins (5–)7–11(–13) pairs, plane beneath, marginal veins 1–2 mm from margin; *petiole* 0.5–1.5 cm long, not thickened, *drying black*, glabrous. **Inflorescences** axillary or extra-axillary, solitary or fascicled, *many-flowered panicle* with second and third order branching, (1.5–)3–6.5 cm, finely pubescent, lowermost branch *c.* 3 cm long, branches with 6–10 flowers clustered at the tips; peduncle (1–)4–7 mm long; bracts scarious, ovate, 1–2 mm long, persistent, minutely pubescent. **Flowers** *polygamous*, yellow-green or creamy white; buds pointed; pedicel 0–1 mm long. **Bisexual flowers:** *calyx c.* 1 mm long, divided about halfway, lobes acute, *densely grey hairy*; corolla 1–3 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens subsessile, anthers less than 1 mm long, oblong; ovary ovoid, *c.* 1.5 mm long, glabrous, stigma bilobed. **Male flowers:** buds less than 1 mm across and strongly reflexed, other characters similar to bisexual flowers but without vestige of ovary. **Infructescences** not thickened. **Fruits** *pear-shaped*, to *1.2 × 0.8 cm*, *smooth*, *not curved*; pericarp purplish red or bluish black; endocarp drying thin and brittle, *c.* 0.3 mm thick; stalk 1–5 mm long. **Seeds** albuminous.

Vernacular names. Sabah—*balit tangan* (Dusun), *kayu rambis* (Sungei Kinabatangan). Sarawak—*borah serang* (Kelabit).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei, and Kalimantan), Sulawesi, Maluku, and New Guinea. In Sabah, common and widespread (e.g., *SAN 19195*, *SAN 28252*, *SAN 49386*, *SAN 65580*, *SAN 84823*, and *SAN 118967*). In Sarawak, widespread but not

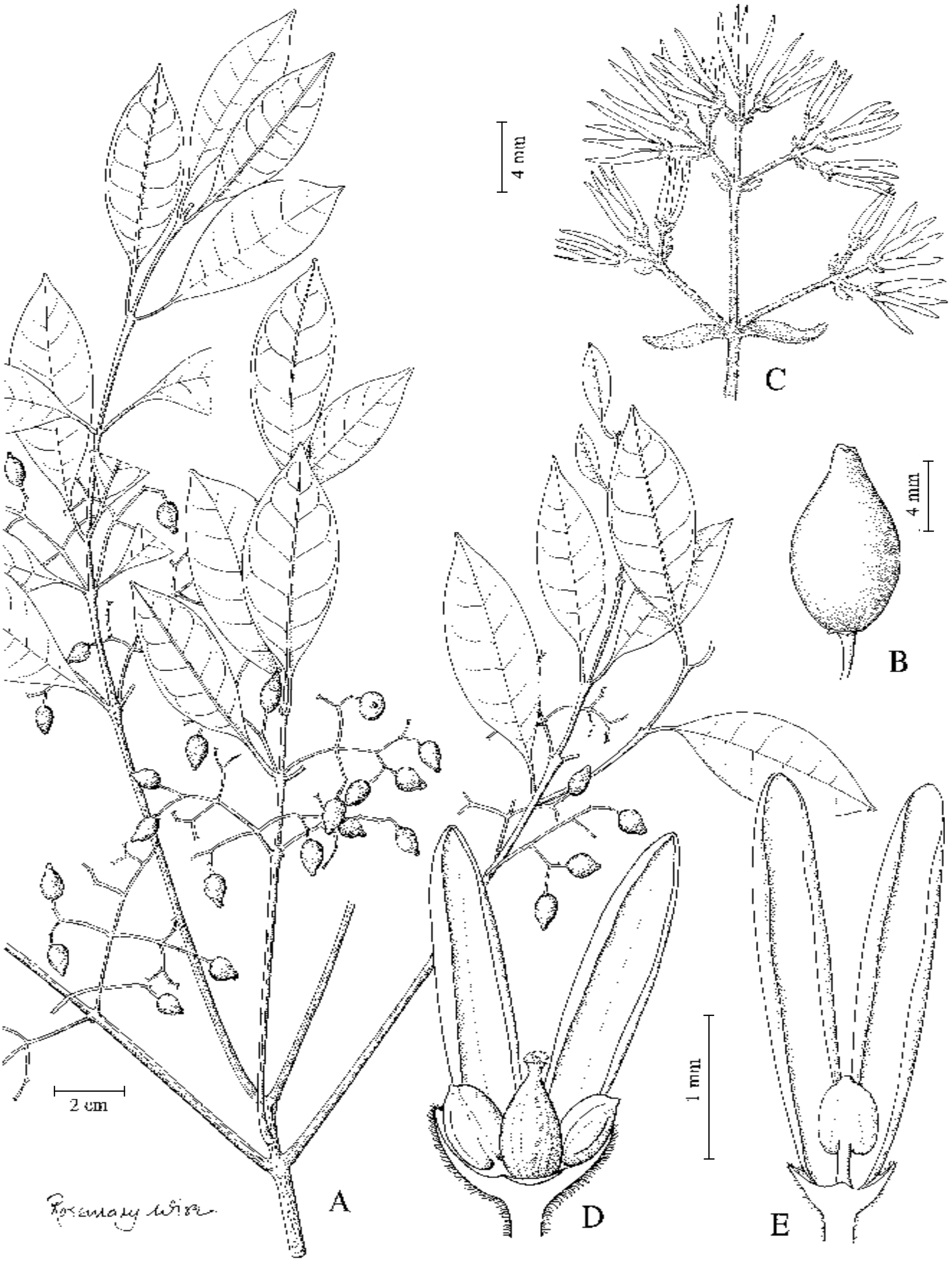

Fig. 4. *Chionanthus polygamus*. A, fruiting leafy twig; B, fruit; C, part of inflorescence; D, longitudinal section of bisexual flower with two calyx lobes and two corolla lobes removed; E, longitudinal section of male flower with two calyx lobes, two corolla lobes and one stamen removed. (A–B from *SAN 27505*, C–D from *SAN 111456*, E from *SAN A 429*.)

as common (e.g., *S 29027*, *S 32030*, *S 34859*, *S 37588*, and *S 50994*). In Brunei, known from Belait, Temburong and Tutong districts (e.g., *BRUN 220* and *S 2001*). In Kalimantan, recorded from Martapura and W Kutei (e.g., *Korthals s.n.*, *Kostermans 12911* and *Kostermans 13036*).

Ecology. Primary or disturbed forest. In Sabah often found in forest on sandy soil or in swamp forest usually below 500 m altitude. In Sarawak usually occurs in *kerangas* forest at altitudes to 1400 m.

Uses. In the Kelabit Highlands, the wood is recorded as being used for building construction and the heartwood for carving tobacco pipes.

20. **Chionanthus porcatus** Kiew Fig. 5.

(Latin, *porcatus* = ridged; referring to the fruit)

Malay. For. 43 (1980) 387, *l.c.* (1981) 149. **Type:** *Singh SAN 28311*, Borneo, Sabah, Ranau district, Bt. Kulong (holotype SAN; isotypes KEP, L).

Tree, 7–20(–30) m tall, to 50 cm diameter; bole with buttresses to 4 m tall. **Bark** fissured or scaly, white or dark grey; inner bark greyish or orange-brown. **Sapwood** whitish. **Twigs** stout, *round in cross-section*, drying reddish brown, nodes strongly flattened, lenticels conspicuous, glabrous. **Leaves** *subcoriaceous*, glabrous, drying pale, greenish brown; *obovate*, 15–32 × 4–14 cm, *base tapering* or *narrowly cuneate*, margin slightly recurved, apex acute; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins 11–16(–22) pairs, marginal veins 1–4 mm from margin; *intercostal venation obscure*; *petiole 2.5–5.5 cm long*, not thickened, *drying* black. **Inflorescences** axillary, produced on new shoots, solitary, *paniculate* with third order branching, 4–11 cm long, lowest branch 1–2.5 cm long; flowers clustered at tips of branches, pubescent; *peduncle more than half the length of inflorescences*, flattened, 2.4–8 cm long; bracts foliaceous, spathulate, to 7 × 5 mm, glabrous, persistent. **Flowers** bisexual, greenish yellow or white, fragrant; *buds pointed*; pedicel 0–2 mm long; calyx *c.* 1.5 mm long, fleshy, divided almost to base, lobes acute, pubescent; corolla *c.* 2 mm long, divided almost to base, lobes oblong, more or less straight at anthesis, minutely pubescent; stamens sessile, anthers oblong, *c.* 1 mm long, connective broad; ovary ovoid, *c.* 1.5 mm long, pubescent, stigma bilobed. **Infructescences** thickened, 8–17 cm long. **Fruits** broadly ellipsoid, *4.5–6.5 × 2.5–3.5 cm*, *not curved*, *with deep 5 main longitudinal ridges*, based rounded, apex pointed, asymmetric, straight on one side, rounded on the other; *pericarp* black, *c. 6 mm thick*; mesocarp woody; pedicel *c.* 12 × 5 mm. **Seeds** albuminous.

Distribution. Endemic to Borneo (Sabah, Sarawak and SE Kalimantan). In Sabah, known from Keningau, Lahad Datu, Ranau, Sandakan, Tambunan, Tawau, and Tenom districts (e.g., *SAN 28311*, *SAN 43052*, *SAN 87768*, *SAN 121039*, and *SAN 132636*). In Sarawak, recorded only from Bario, Ulu Baram (e.g., *S 53545* and *S 53546*). In Kalimantan, reported from Sg. Kerajaan and Sg. Menumbar (e.g., *Kostermans 4963* and *Kostermans 5879*) and NE Pontianak (e.g., *Burley et al. 2952*).

Ecology. Primary, sometimes secondary, lowland forest, frequently on hillsides, at altitudes to 650 m.

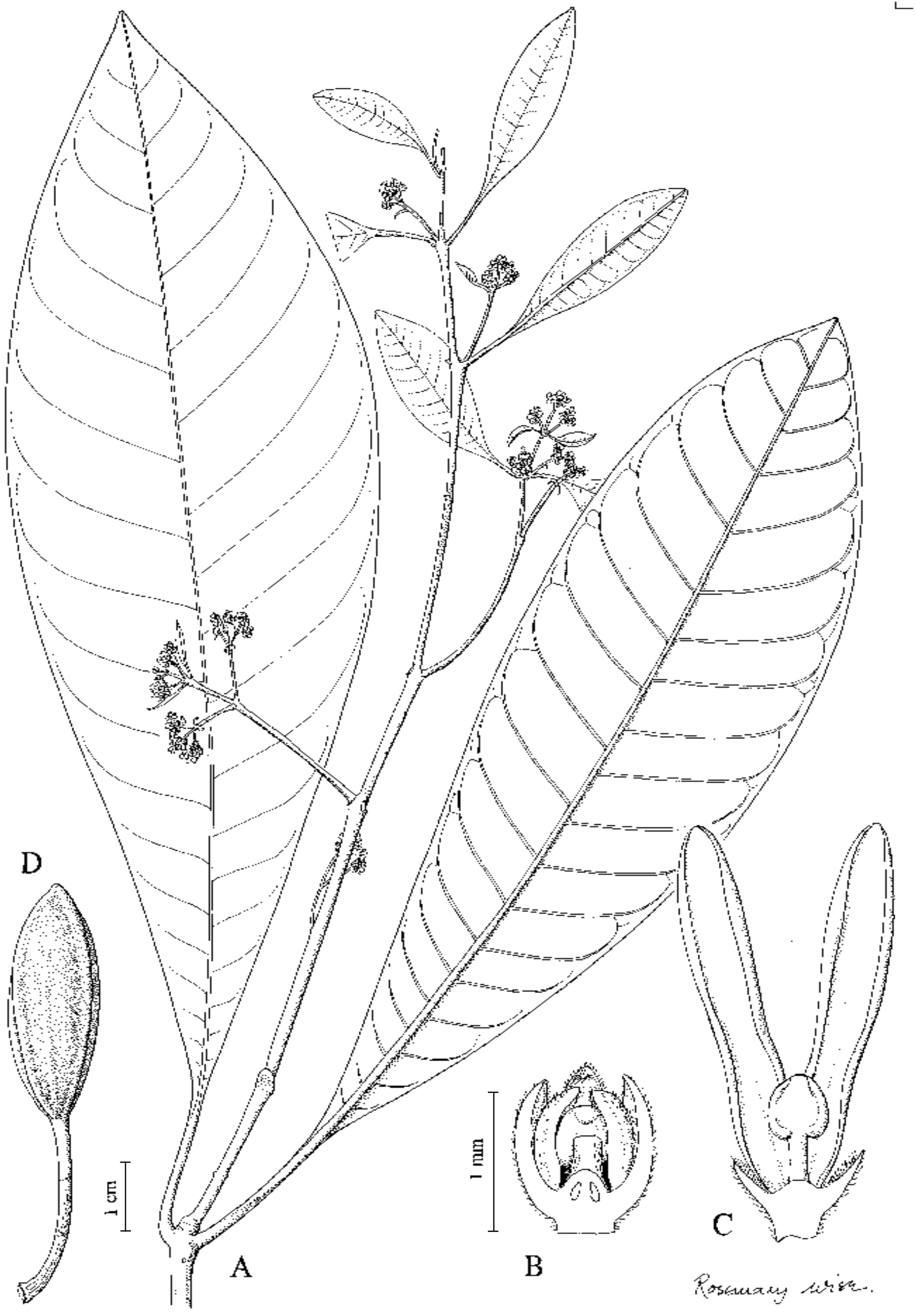

Fig. 5. *Chionanthus porcatus*. A, flowering leafy twig; B, longitudinal section of bisexual flower bud; C, longitudinal section of open male flower; D, fruit. (A–C from *SAN 57768*, D from *SAN 28311*.)

21. **Chionanthus pubicalyx** (Ridl.) Kiew

(Latin, *pubi-* = hairy; referring to hairy the calyx)

Malay. For. 44 (1981) 156. **Basionym:** *Linociera pubicalyx* Ridl., Kew Bull. (1934) 122. **Type:** *Haviland 1442*, Borneo, Sabah, Pulau Gaya (holotype K; isotypes SAR, SING).

Tree to 40 m tall and 30 cm diameter, flowering at *c*. 6 m tall; bole occasionally with buttresses *c*. 30 cm high. **Bark** whitish or grey, flaking; inner bark yellow. **Sapwood** white or yellowish, turning pinkish on exposure. **Twigs** slender, *round in cross-section*, dark grey, glabrous, flattened at nodes. **Leaves** *subcoriaceous*, glabrous, *drying dull and plane above*, *greenish grey* or *greenish brown with lateral veins slightly darker than leaf blade beneath*; *broadly elliptic* to *lanceolate*, (*6–*)*13*(*–15*) × (*2.5–*)*5.5 cm*, *broadest at the middle*, *base cuneate becoming shortly decurrent*, margin finely recurved, *apex acuminate* to *cuspidate*, acumen 0.5–1.5 cm long; midrib slightly raised above and prominent beneath; lateral veins 5–9 pairs, plane and obscure above, slightly prominent beneath, marginal veins 2–3 mm from margin; *petiole* 0.5–1.25 cm long, moderately thickened, *drying black*. **Inflorescence** axillary, solitary, *paniculate with first order branching*, *1.5–5 cm long*, branches in 4–5 tiers, lowermost 1.5–2.5 cm long, upper branches decreasing in length, each with a cluster of 3–4 flowers at the tips, glabrous; peduncle 0.25–0.75 cm long; bracts scale-like, ovate, 1.5–2 mm long, pubescent persistent. **Flowers** *bisexual*, white or pale yellow, with slight citron fragrance (*Chew et al. 2762*); pedicel (0.5–)1–1.5 mm long; calyx 1–1.5 mm long, divided less than halfway, lobes acute, pubescent; corolla (2–)3–5 mm long, divided almost to base, lobes narrowly linear, involute, apex cucullate, straight at anthesis, glabrous; stamens almost sessile, epipetalous, anther *c*. 1 mm long, apex apiculate; ovary ovoid, stigma capitate or obscurely bilobed. **Infructescences** slightly thickened, to 4 cm long. **Fruits** *ovoid* with rounded apex, *to 2 × 1.5 cm*, or rotund with diameter 1.7 cm, *smooth*, *not curved*; pericarp dull purple, brittle, *c*. 1 mm thick; stalk 1–2 mm long. **Seed** endospermous.

Distribution. Endemic to Borneo. Common in Sabah (e.g., *Clemens 29397*, *SAN 28302*, *SAN 31651*, *SAN 42097*, *SAN 87412*, and *SAN 121740*), infrequent in Sarawak (e.g., *S 40309*) and Brunei (e.g., *SAN 17574*).

Ecology. Primary mixed dipterocarp forest or in disturbed or secondary forest on hill sides or ridges, at altitudes to 1600 m (G. Kinabalu).

22. **Chionanthus ramiflorus** Roxb.

(Latin, *ramiflorus* = flowering on the older branches)

Fl. Ind. 2nd. edition 1 (1832) 107; Kiew, Malay. For. 42 (1979) 274, *l.c.* (1980) 388, *l.c.* (1981) 150, *l.c.* (1989) 289; Corner, WSTM 3rd. edition 2 (1988) 601; Coode *et al.* (eds.) *l.c.* 248. **Type:** *Wight Ic. no. 734*. **Synonyms:** *Linociera ramiflora* (Roxb.) Wall. *ex* A.DC., Prodr. 8 (1844) 297, Merrill *l.c.* (1921) 489, Masamune *l.c.* 613, Backer & Bakhuizen *f. l.c.* 214, Anderson *l.c.* 285; *Olea pauciflora* Wall. *ex* DC. *l.c.* 297; *L. pauciflora* (Wall. *ex* A.DC.) C.B.Clarke *in* Hooker *f.*, Fl. Br. Ind. 3 (1882) 609, King & Gamble *l.c.* 266, Merrill *l.c.* (1921) 489, Ridley *l.c.* (1923) 317, Masamune *l.c.* 612, Corner *l.c.* 601.

Tree to 20 m tall and 30 cm diameter. **Bark** smooth, grey-brown, lenticellate; inner bark brown. **Sapwood** whitish yellow. **Twigs** slender, *round in cross-section*, drying white or light grey, nodes flattened, lenticels conspicuous, glabrous. **Leaves** *chartaceous* or *subcoriaceous*, glabrous, *drying green-brown on both surfaces*, glossy above; *oblong-lanceolate*, *elliptic* or *obovate*, (6.5–)9–15(–29) × (2–)4–7(–10.5) cm, *base cuneate*, *rounded* or *sometimes decurrent*, margin slightly recurved, apex acuminate, rounded or sometimes acute; midrib impressed above; lateral veins 8–12 pairs, plane above, prominent beneath, marginal vein *c.* 2 mm from margin; *intercostal venation conspicuous*; *petiole 1.5–3 cm long*, not thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate with second* or *third order branching* and 3–6 distant branches, (0.5–)3–13 cm long, lowest branch (0.5–)1.5–3(–5) cm long; *flowers spaced*, glabrous; peduncle 1.5–3.25 cm long; bracts foliaceous, spathulate, 3–15 mm long, glabrous, persistent. **Flowers** *bisexual*, white or pale yellow, fragrant; pedicel 1–3 mm long; *buds rounded*; calyx less than 1 mm long, divided almost to base, lobes acute, glabrous; corolla 2–3 mm long, divided almost to base, lobes oblong, joined in pairs for *c.* a quarter of the length, more or less straight at anthesis; stamens sessile, anther oblong, *c.* 1 mm long, yellow; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 12 cm long. **Fruits** ellipsoid, *2(–4)* × *1(–2) cm*, *smooth*, *not curved*, apex blunt or apiculate, often galled; *pericarp* purple-black, *drying thin and brittle*; stalk 2–5 mm long, conspicuously swollen. **Seeds** exalbuminous; cotyledons fleshy.

Distribution. E India, Indo-China, Taiwan, throughout Malesia to Australia (Queensland), and the Solomon Islands. In Borneo, common and widespread. In Sabah, recorded from many localities (e.g., *SAN 20672*, *SAN 44556*, *SAN 56112*, *SAN 76234*, and *SAN 80678*). In Sarawak, known from Bau, Kuching, Limbang and Marudi districts (e.g., *Haviland 1766*, *Nooteboom & Chai 2133* and *S 41183*). Also occurs in Brunei (e.g., *Atkins SA 451*, *BRUN 5143*, *Simpson DS 2182*, and *Wong WKM 150*) and Kalimantan.

Ecology. Primary and secondary forests, frequent in coastal and riverine vegetation at altitudes below 300 m, but occasionally also found in lower and upper montane forests, at altitudes to 2200 m.

Notes. Galls replacing fruits are not infrequent in this species. One type is easily recognisable as a gall as it is composed of disorganised corky abnormal growth; the other type has the appearance of a fruit rather resembling those of *C. polygamus* in the acutely pointed apex. Besides the shape, the galls also differ from normal fruits in being smaller, *c.* 1 × 0.5 cm, brown and somewhat shiny.

23. **Chionanthus rugosus** Kiew

(Latin, *rugosus* = rough and pimply; referring to fruit surface)

Malay. For. 43 (1980) 389, *p.p.* **Type:** *Banyeng & Sibat S 27067*, Borneo, Sarawak, Semengoh FR (holotype SAR; isotypes A, L).

Tree to 20 m and 10 cm diameter. **Bark** smooth, greyish. **Twigs** slender, *round in cross-section*, drying white, slightly flattened at nodes, without lenticels, sparsely pubescent when young. **Leaves** *subcoriaceous*, glabrous, *drying dull and plane above*, chestnut- or olive-brown on both surfaces; *lanceolate*, *widest at or above the middle*, 8–14.5 × 2.5–5 cm, *base tapered*, margin recurved, *apex cuspidate*, acumen 1–1.5 cm long; midrib slightly impressed above, prominent beneath; *lateral veins* 4–7 pairs, slightly impressed above, *prominent beneath*, marginal vein *c.* 2 mm from margin; *intercostal venation obscure*; *petiole* 0.3–0.6 cm long, not thickened, *drying black*. **Inflorescences** and **flowers** unknown. **Infructescences** axillary or extra-axillary, *racemose*, 0.3–2 cm long; peduncle to 0.5 cm long, thickened. **Fruits** green (?immature), ovoid, *c. 0.7 × 0.5 cm*, *rugose*, *not curved*, apex rounded, base narrowed; stalk *c.* 4 mm long and 2 mm thick. **Seeds** unknown.

Distribution. Endemic to Borneo and known only from the Semengoh FR in Sarawak (e.g., *S 24925*, *S 26287* and *S 27067*).

Ecology. Lowland mixed dipterocarp forest on hill slopes or river banks.

24. **Chionanthus sabahensis** Kiew

(of Sabah, Borneo)

TFSS 4, App. (2002) 354. **Type:** *Carr SFN 27170*, Borneo, Sabah, G. Kinabalu, Ulu Kinunut (holotype SING).

Tree to 13 m tall and 10 cm diameter. **Bark** smooth, green; inner bark grey-brown. **Sapwood** white. **Twigs** slender, *round in cross-section*, glabrous, flattened at nodes, drying pale brown, sometimes lenticellate. **Leaves** *slightly subcoriaceous*, glabrous, *dull and plane above*, *drying greenish grey above and green-brown beneath*; *narrowly lanceolate*, *14–21.5 × 3.5–6 cm*, *widest at the middle*, *base cuneate* sometimes unequal, margin slightly recurved, *apex acute* to *acuminate*; midrib impressed above, prominent beneath; *lateral veins* 9–11 pairs, slightly impressed above, *slightly concolorous with leaf blade and prominent beneath*, marginal vein 1–3 mm from margin; intercostal venation obscure; *petiole* 0.75–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *racemose panicle with first order branching*, *7–13 cm long*, lower branches 2–3 cm long with flowers clustered at tips of branches; peduncle 1–2 cm long; bracts scarious, ovate, *c.* 0.75 cm long, minutely pubescent, persistent. **Flowers** *bisexual*, greenish white; pedicel 1–1.5 mm long; calyx *c.* 0.5 mm long, divided *c.* halfway, lobes acute, margin ciliate; corolla and stamens not known; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, 4–10 cm long. **Fruits** *globose*, *up to 2.3 cm diameter*, *smooth*, *not curved*, ripening cream-green or bright-green; pericarp sometimes with white lenticels, *c.* 1.5 mm thick; endocarp woody; stalk 2–3 × 3 mm. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Sabah (e.g., *Beaman et al. 10447*, *Clemens 27568*, *Clemens 28847*, *Clemens 31588*, *Price 218*, and *SAN 41890*).

Ecology. Lower montane forest at 1350–2200 m altitude.

25. **Chionanthus spicatus** Blume

(Latin, *spicatus* =bearing a spike; referring to the spicate inflorescence)

Mus. Bot. Lugd. Bat. 1 (1850) 318; Coode *et al.* (eds.) *l.c.* 248. **Type:** *Korthals s.n.* (= *RHL Sheet No. 908161119*), Borneo, Kalimantan, G. Bataran (holotype L). **Synonyms:** *Linociera spicata* (Blume) Knobl. *l.c.* 87; *L. oligantha* Merr. *l.c.* (1918) 118, *l.c.* (1921) 489, *l.c.* (1929) 249, Masamune *l.c.* 612, Anderson *l.c.* 285; *Chionanthus oliganthus* (Merr.) Kiew *l.c.* (1980) 379, *l.c.* (1981) 152.

Small tree, *3–8(–17) m tall*, to 20 cm diameter. **Bark** smooth, greyish; inner bark yellow-orange. **Sapwood** pinkish white. **Twigs** *slender*, *round in cross-section*, drying white, slightly flattened at nodes, lenticels inconspicuous, glabrous. **Leaves** chartaceous to subcoriaceous, glabrous, *drying* *dull*, *pale grey-green*; narrowly lanceolate to elliptic-oblong, sometimes slightly obovate, *10–17 × 3.5–7 cm*, *base narrowly cuneate* to *shortly decurrent*, margin not recurved, *apex cuspidate* (or sometimes acuminate), acumen 1–2 cm long; midrib and lateral veins slightly impressed above, prominent beneath; *lateral veins 5–8 pairs*, marginal vein 2–5 mm from margin; *petiole 0.5–0.7*(*–1*) *cm long*, thickened, *drying fawn*. **Inflorescences** axillary or sometimes extra-axillary, solitary or in pairs, racemose with 3–5 pairs of distant flowers, 0.5–1.5 cm long; peduncle 0.2 cm long, glabrous or sparsely pubescent; bracts scarious, ovate, *c.* 1.5 mm long, pubescent. **Flowers** bisexual, creamy white or yellowish green, sometimes purple inside, fragrant; buds pointed; pedicel to 1 mm long; calyx 0.5–1.5 mm long, divided almost to base, lobes ovate or rounded, glabrous or sparsely pubescent; corolla 4–8(–11) mm long, divided almost to base, lobes narrowly linear, slightly twisted at anthesis; stamens sessile, attached at base of corolla, anther oblong, *c.* 1 mm long; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 2 cm long. **Fruits** *globose*, *c. 1.8 cm diameter*, *smooth*, *not curved*, apex rounded; pericarp purple-black, 1–2 mm thick; endocarp leathery; stalk *c.* 3 mm long and 3 mm thick. **Seeds** albuminous.

Vernacular name. Kalimantan—*nginjojo* (Land Dayak).

Distribution. Borneo (Sabah, Sarawak, Brunei, and Kalimantan) and the Philippines. In Sabah, recorded from most districts (e.g., *SAN 16094*, *SAN 16590*, *SAN 54361*, and *SAN 56850*). In Sarawak, known from Bau, G. Buri, G. Pueh, Bt. Mersing, Kelabit Highlands, and Melinau (e.g., *S 36767*, *S 48920*, *S 48986*, and *S 53526*). In Brunei, recorded by two collections (*Dransfield JD 7394* and *Schatz 3252*) from Kuala Belalong Field Study Centre in Temburong district and in Kalimantan known from Bt. Baka NP and Kota Waringin (e.g., *Argent & Amiril 9382*, *Church et al. 158* and *Church et al. 490*).

Ecology. Lowland mixed dipterocarp to lower montane forest, at altitudes to 1500 m, on limestone scree and occasionally in *kerangas* forest.

Incompletely known species

1. **Chionanthus sp. 1**

Tree to 7 m tall. **Twigs** white. **Leaves** drying deep chestnut-brown on both surfaces; broadly lanceolate, to 23 × 11 cm; lateral veins 12–14 pairs, impressed above, prominent beneath; petiole stout, *c.* 1.25 cm long, drying black. **Inflorescence** a twice branched panicle, *c.* 2.5 cm long. **Fruits** unknown.

Specimens examined: Borneo, Sarawak, G. Santubong, *Banyeng & Sibat S 21518*; G. Pueh, *Clemens 20115* (previously identified as *C. longipetalu*s).

2. **Chionanthus sp. 2**

Tree *c.* 20 m tall. **Twigs** drying brown. **Leaves** drying pale brown; lanceolate to slightly ovate, 10–16 × 5–6 cm; lateral veins 8–10 pairs, deeply impressed above, prominent beneath; petiole stout, *c.* 1 cm long, drying black. **Inflorescence** a twice branched panicle, 3.5–6 cm long. Petals *c.* 4 mm long, twisted on anthesis. **Fruits** unknown.

Specimens examined: Borneo, Sabah, G. Kinabalu, *Chew et al. 286*; Brunei, Bt. Belalong, *Wong WKM 1394*.

3. **Chionanthus sp. 3**

Twigs white. **Leaves** drying chestnut-brown on both surfaces; lanceolate, *c.* 11 × 4.5 cm, apex cuspidate; lateral veins 9–11 pairs, deeply impressed above, prominent beneath; petiole *c.* 0.5 cm long, drying black. **Inflorescence** a short raceme, 1–1.5 cm long. Petals 5–6 mm long, twisted at anthesis. **Fruits** unknown.

Specimens examined: Borneo, Sarawak, Kuching, *Haviland 2167* (previously identified as *C. longipetalus*).

2. **LIGUSTRUM** L.

(Latin name for the privet bush)

Sp. Pl. 1 (1753) 7; Backer & Bakhuizen *f.*, FJ 2 (1965) 215; Kiew, Blumea 24 (1978) 143, TFM 4 (1989) 290; Corner, WSTM 3rd. edition 2 (1988) 602.

Shrubs or *small trees*. **Leaves** *simple and entire*, elliptic to more or less ovate, rarely linear. **Inflorescences** *terminal*, sometimes also axillary, paniculate, usually hairy; bracts foliaceous. **Flowers** bisexual, *to 8 mm long*; calyx shortly tubular with 4 small teeth; *corolla tubular with 4 lobes as long* or *longer than tube*, lobes induplicate-valvate in bud, opening more or less horizontally, white or yellow; stamens with thin filaments, anthers projecting beyond corolla tube; ovary globose, *style 1–2 mm long*, projecting beyond calyx after the corolla has fallen. **Fruits** *fleshy*, *drupaceous*, with 1 to 3 endospermic, *non-winged* seeds.

Distribution. About 40 species, the majority occur in temperate Asia, extending to Europe and through Malesia to Australia. In Sabah, one species is known.

Ecology. Usually in open places in lowland to montane forest.

Uses. In Europe, the Japanese *L. ovalifolium* Hassk. is a common hedge plant. *L. sinense* Lour. is used for a similar purpose in Asia, for example, it has been planted in the hill stations in Peninsular Malaysia.

Ligustrum glomeratum Blume Fig. 6.

(Latin, *glomeratum* = collected closely together in a head; referring to the crowded flowers on the tips of inflorescence branches)

Mus. Bot. Lugd. Bat. 1 (1850) 314; Backer & Bakhuizen *f. l.c.* 215; Kiew *l.c.* (1978) 147, *l.c.* (1989) 290. **Lectotype** (Kiew, 1978)**:** *Blume 945*, Java (holotype L).

Shrub or small tree to 15 m tall. **Twigs** pale brown, densely pubescent near apex, lenticellate. **Leaves** chartaceous to subcoriaceous, glossy above, glabrous beneath, or densely hairy on midrib

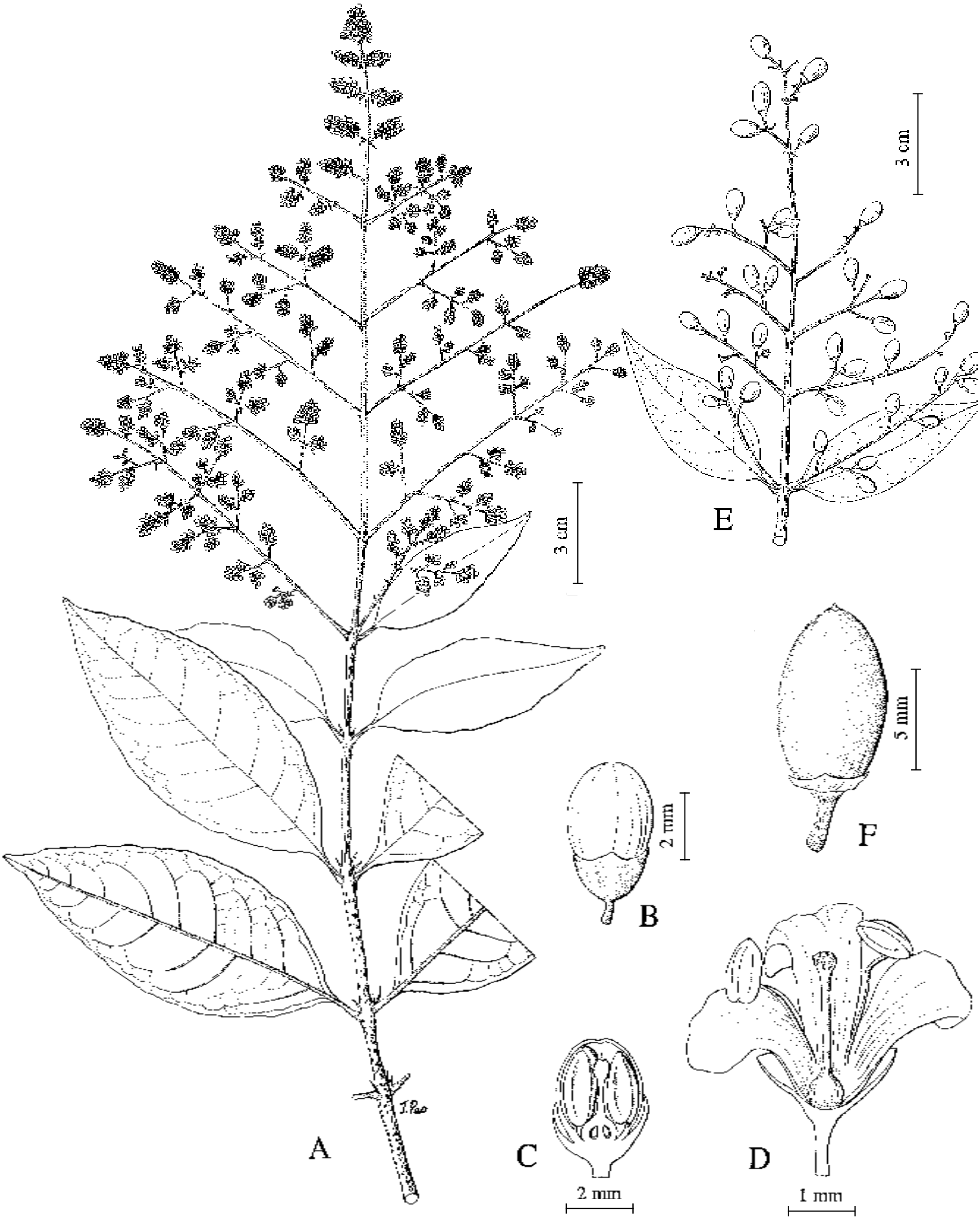

Fig. 6. *Ligustrum glomeratum*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, longitudinal section of flower with one corolla lobe removed; E, infructescence; F, fruit. (A–D from *SAN 123276*, E–F from *SAN 124962*.)

beneath; ovate-lanceolate to oblong, (3–)7–8(–9) × (2–)3.5(–5) cm, base cuneate to decurrent, apex acuminate to cuspidate (rarely obtuse); midrib grooved above; lateral veins conspicuous above and beneath, 6–7 pairs; petiole 0.5–0.9 cm long, glabrous or pubescent. **Inflorescences** pyramidal, 8–17 cm long, with 5–7 tiers of branches, lowest branch 6–10 cm long, branches decreasing in length towards apex, more or less horizontal, pubescent to villous; bracts *c.* 3 cm long. **Flowers** sweetly scented, densely clustered, subsessile or with pedicel to 1 mm long; calyx scarcely lobed, tube *c.* 1 mm long, glabrous; corolla white or yellow, tube *c.* 1 mm long, lobes 1–2(–3) mm long; stamens with filaments *c.* 2 mm long, anthers projecting beyond corolla tube in open flowers; style 1–2 mm long, slender and projecting beyond calyx in open flower. **Fruits** ellipsoid to obovoid, 0.5–0.8 × 0.4–0.5 cm, fleshy, ripening dark purple, tasting bitter sweet, 1(–3)-seeded; stalk 1–5 mm long.

Distribution. S Thailand, Peninsular Malaysia, Sumatra, Borneo (Sabah), the Philippines, Java, Lesser Sunda Islands, Sulawesi, Maluku, and New Guinea. In Sabah, locally common in Kota Belud, Ranau and Tambunan districts (e.g., *SAN 28544*, *SAN 33070*, *SAN 89464*, *SAN 95525*, and *SAN 116550*).

Ecology. In primary and secondary lowland and hill mixed dipterocarp forest, near rivers or on hill slopes, at altitudes to 1600 m.

3. **OLEA** L.

(Latin name for olive tree)

Sp. Pl. 1 (1753) l8; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 269; Ridley, FMP 2 (1923) 318; Backer & Bakhuizen *f.*, FJ 2 (1965) 214; Kiew, Blumea 25 (1979) 307, TFM 4 (1989) 291, Gard. Bull. Sing. 51 (1999) 85; Corner, WSTM 3rd. edition 2 (1988) 603.

Shrubs or *small to medium-sized trees*. **Twigs** whitish or brown, glabrous, sometimes minutely pubescent. **Leaves** *simple*, *margin entire* or *toothed*, coriaceous, sometimes membranaceous, elliptic-lanceolate to ovate, minutely lepidote. **Inflorescences** paniculate, *axillary* or *ramiflorus*, glabrous or minutely pubescent; bracts foliaceous, small and caducous. **Flowers** *1–5 mm long*, *polygamous* or *unisexual*; *buds rounded*; calyx short, tubular, divided *c.* halfway, persistent; *corolla tube as long or slightly longer than lobes*, *lobes 4*, induplicate-valvate, apex cucullate and scarcely opening, white or yellow, glabrous; stamens 2, attached near base of corolla tube, anthers subsessile, broadly oblong, *c.* 1 mm long; ovary *c.* 2 mm long, *style very short*, *stigma sessile* or *subsessile*, weakly bilobed. **Fruits** *fleshy and drupaceous*; epicarp thin and fleshy; mesocarp and endocarp thin and crustose or bony. **Seeds** *not winged*, with bony or fleshy endocperm.

Distribution. About 30 species; Mediterranean, Africa, Madagascar, E Asia, Malesia, Australia, New Zealand, and Polynesia. In Sabah and Sarawak three (3) species are known.

Ecology. Mostly in primary lowland mixed dipterocarp forest but *Olea rubrovenia* extends to upper montane forest, at altitudes to 3800 m on G. Kinabalu.

Key to *Olea* species

1. Leaf margin entire; lateral veins deep red and conspicuous beneath. Axillary buds large and mammiform .... **3. O. rubrovenia**
   Leaf margin serrate or subserrate; lateral veins concolourous with leaf blade beneath. Axillary buds small 2

2. Leaves frequently obovate; petiole conspicuously thickened, drying pale fawn. Flowers to 1 mm long. Fruits 0.8–1.5 × 0.5–0.8 cm .... **1. O. borneensis**
   Leaves lanceolate; petiole not thickened, drying black. Flowers 1.5–2.5 mm long. Fruits to 0.5 cm diameter .... **2. O. brachiata**

1. **Olea borneensis** Boerlage Fig. 7.

(of Borneo)

Handl. Fl. Ned. Ind. 2 (1899) 332; Kiew, Blumea 25 (1979) 308, *l.c.* (1989) 291, *l.c.* (1999) 89. **Type:** *Korthals s.n.* (= *RHL Sheet No. 908155551*), Borneo, Kalimantan, without locality (holotype L).

Tree to 25 m tall and 20 cm diameter; clear bole to 5 m tall. **Bark** smooth or scaly, whitish or light grey; inner bark reddish or orange-brown. **Sapwood** white. **Twigs** white, glabrous, flattened at nodes; *axillary buds small*. **Leaves** thinly coriaceous, minutely punctate beneath, drying greyish or brownish green; *frequently obovate*, (7–)14(–17) × 3–8 cm, base cuneate, *margin serrate* or *subserrate in the upper half*, finely recurved, apex broadly acute to shortly acuminate, rarely rounded; midrib slightly impressed above; *lateral veins* 6–9 pairs, ascending, *concolorous with leaf blade beneath*, inconspicuous or slightly impressed above, obscure or slightly prominent beneath, marginal vein *c.* 3 mm from margin; intercostal venation obscure; *petiole* 0.5–1 cm long, *conspicuously thickened*, *drying pale fawn*. **Inflorescences** solitary or fascicled, slender, 1.5–8 cm long, lateral branches 0.5–1.5 cm long, of equal length; flowers distantly spaced, 4–8 per branchlet; peduncle (0.2–)0.5–1.5 cm long; bracts minute. **Flowers** polygamous, *to 1 mm long*; pedicel 1–1.5 mm long; calyx margin sparsely ciliate; corolla whitish or yellowish green, tube twice as long as the cucullate lobes; stamens subsessile, attached halfway on corolla tube, anthers 0.5–0.75 mm long and wide, apex scarcely exposed as the lobes open. **Male flowers** (buds) spherical and minute to 1 mm diameter, calyx lobes acute, corolla 1–2.5 mm long. **Bisexual flowers** with scarcely lobed calyx, corolla *c.* 1.8 mm long, stamens as in male flowers, ovary ellipsoid, *c.* 1 mm long, narrowing abruptly to the slightly bifid minute stigma. **Fruits** broadly ellipsoid to almost globose, *0.8–1.5 × 0.6–0.8 cm*, apex rounded, stigma persistent, ripening black; endocarp thin and woody, *c.* 0.5 mm thick. **Seeds** endospermic.

Distribution. Borneo (Sabah and Kalimantan) and the Philippines. In Sabah, common (e.g., *SAN 18808*, *SAN 54929*, *SAN 57438*, *SAN 77236*, and *SAN 90777*). In Kalimantan, known by the type and *bb. 12037* from Martapura.

Ecology. In primary mixed dipterocarp to lower montane forest, frequently on steep slopes and ridges, at altitudes to 1650 m, including on ultramafic soils (Bt. Hampuan, Sabah).

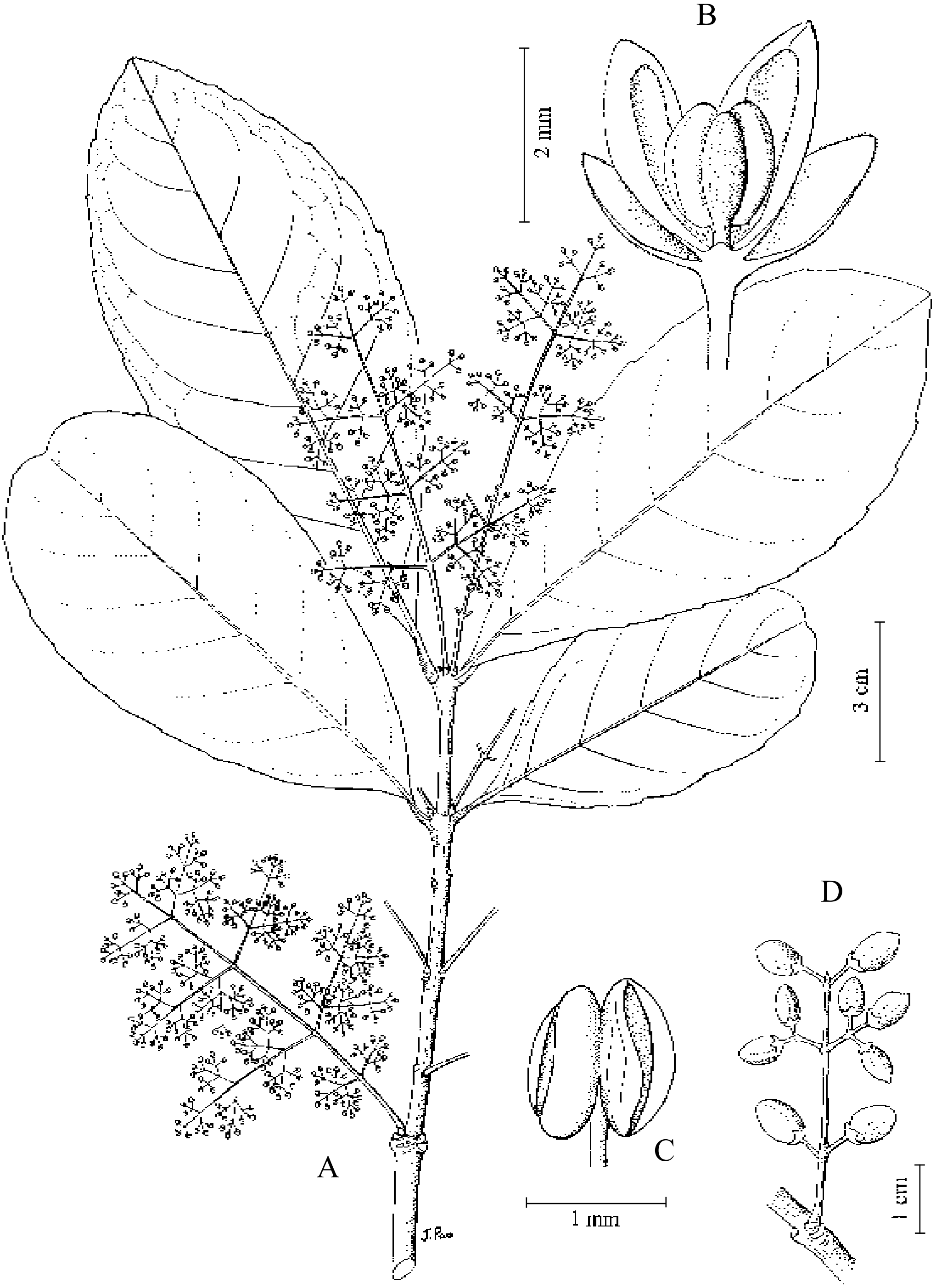

Fig. 7. *Olea borneensis*. A, flowering leafy twig; B, longitudinal section of male flower with two calyx lobes, two corolla lobes and one stamen removed; C, dehiscing stamen; D, infructescence. (A–C from *SAN 54929*, D from *SAN 90777*.)

2. **Olea brachiata** (Lour.) Merr.

(Latin, *brachiatus* = branched in a decussate manner; referring to the inflorescence)

Lingn. Agr. Rev. 2 (1925) 127; Kiew, Blumea 25 (1979) 308, *l.c.* (1989) 291, *l.c.* (1999) 90; Corner *l.c.* 603. **Basionym:** *Tetrapilus brachiatus* Lour., Fl. Cochinchina 2 (1790) 611. **Type:** *Louriero s.n.*, Indo-China (holotype BM). **Synonym:** *O. maritima* Wall. *ex* G.Don, Gen. Syst. 4 (1838) 49, Anderson *l.c.* 285.

Shrub or small tree to 10 m tall and 5 cm diameter. **Twigs** pale brown, minutely pubescent; *axillary buds small*. **Leaves** subcoriaceous, glabrous, not punctate beneath, drying greyish green; *lanceolate*, (4.5–)8–10(–13) × (2–)3–5(–6) cm, base cuneate or somewhat rounded, margin *serrate or subserrate in upper half*, finely recurved, apex strongly acuminate; midrib impressed above, prominent beneath; *lateral veins* 7–10 pairs, obscure and *concolourous with leaf blade beneath*; *petiole* 5–7 mm long, *not thickened*, *drying black*, minutely pubescent when young. **Inflorescences** axillary or extra-axillary, 1–3 cm long, trichotomously branched panicle terminating in subumbels of 3–10 flowers, lowest branches 2–5 mm long, minutely pubescent; peduncle 1–1.5 cm long; bracts leafy, narrowly ovate-lanceolate, caducous. **Flowers** unisexual, *1.5–2.5 mm long*; pedicel to 3 mm long; calyx *c.* 1 mm long, deeply divided, lobes ovate-acute, minutely pubescent; corolla dull white, 1.5–2.5 mm long, divided about halfway down, lobes elliptic with rounded apex, spreading at anthesis. **Male flowers:** buds globose, 1–1.5 mm long, stamens subsessile, anthers *c.* 1–2 mm long. **Female flowers:** ovary globose, stigma subssile, broadly and slightly bilobed. **Fruits** globose, *c. 5 mm diameter*, purple-black when ripe; stalk *c.* 2 mm long. **Seeds** endospermic.

Distribution. Indo-China, Thailand, Sumatra, Peninsular Malaysia, Anambas Is., and Borneo (W Sarawak). In Sarawak, rare, found only on rocky shores around G. Santubong (e.g., *Haviland 3040*).

3. **Olea rubrovenia** (Elmer) Kiew Fig. 8.

(Latin, *rubro* = red, *venia* = veins; referring to the deep red lateral veins)

Gard. Bull. Sing. 51 (1999) 95. **Basionym:** *Linociera rubrovenia* Elmer, Leafl. Philip. Bot. 2 (1909) 586, *ibid.* 5 (1913) 1613; Merrill, Enum Philip. Pl. 3 (1923) 305. **Type:** *Elmer 10224*, the Philippines, Negros Is. (holotype US; isotypes A, K, L). **Synonym:** *Tetrapilus rubrovenius* (Elmer) L.A.S.Johnson, Contrib. N.S.W. Herb. 2 (1957) 408; *Ilex decussata* Heine, Mitt. Bot. Staatsaml. Muenchen 6 (1953) 209; *Olea decussata* (Heine) Kiew, Blumea 25 (1979) 309.

Shrub or tree to 30 m tall and 20 cm diameter. **Bark** smooth, whitish; inner bark orangey. **Sapwood** pale yellow. **Twigs** when young green, drying black, older twigs white with scattered lenticels, glabrous; *axillary buds large and mammiform*, leaving a collar of persistent stiff bud scales around origin of new shoots. **Leaves** coriaceous to thickly coriaceous, glabrous and minutely punctate beneath, drying tan or reddish brown; broadly to rarely narrowly elliptic, 7–14(–22) × (2–)3–5.5(–8) cm, base cuneate or rounded, *margin entire* (in coriaceous leaves strongly recurved), apex acute to acuminate, acumen *c.* 1 cm long; midrib impressed above, prominent beneath; *lateral veins* 6–9 pairs, ascending, plane to finely impressed above, *slightly prominent and deep red* (discolorous with leaf blade) *beneath*, marginal veins 1.5–2 mm from margin; petiole 0.5–1.2(–2.5) cm long, glabrous, drying black and in thickly coriaceous leaves thick and wrinkled. **Inflorescences** axillary and frequently extra-axillary, glabrous or minutely pubescent, (1.5–)3.5–4(–6) cm long, lowest branch *c.* half the length of inflorescence; peduncle

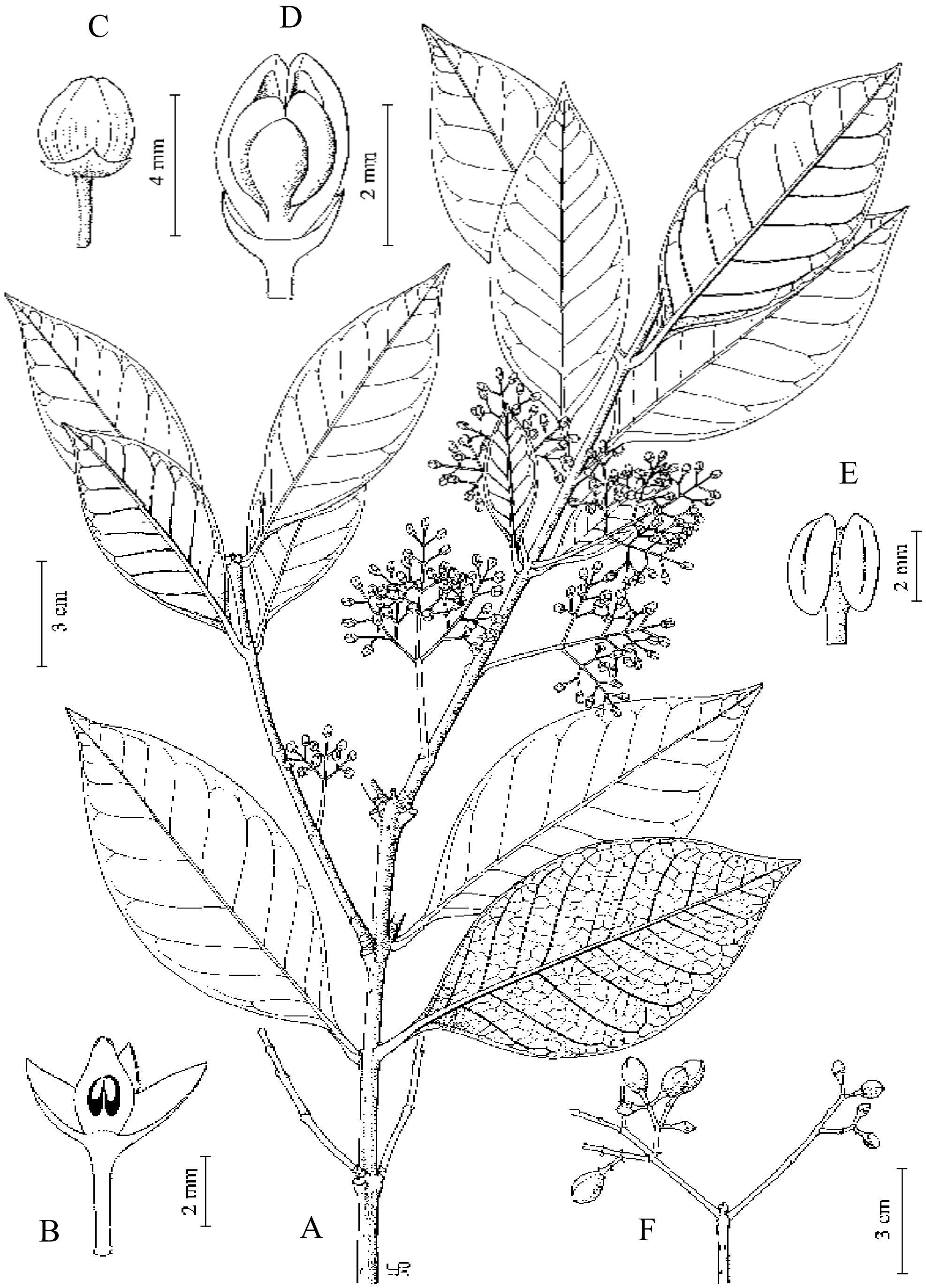

Fig. 8. *Olea rubrovenia.* A, flowering leafy twig; B, longitudinal section of bisexual flower with corolla lobes and stamens removed; C, male flower bud; D, longitudinal section of male flower bud; E, adaxial side of stamen; F, infructescence. (A–B from *RSNB 939*, C–E from *SAN 123235*, F from *SAN 41831*.)

1.5–4 cm long; bracts foliaceous, 7–15 × 3 mm. **Flowers** polygamous; pedicel 1–3 mm long, stout; buds almost globose, *c.* 1.5 mm diameter; calyx *c.* 1 mm long, acute, pubescent with ciliate margin; corolla 1.5–3 mm long, divided for *c.* one third, lobes cucullate, scarcely opening, creamy white or greenish yellow, sweetly scented; stamens subsessile, attached near base of corolla tube, hardly exposed in open flower, anthers *c.* 1 mm long. **Male flowers** frequently spreading. **Bisexual flowers** as for male but with ovary *c.* 2 × 1.3 mm, stigma slightly bilobed. **Fruits** ellipsoid, *c.* 1.5 × 0.5 cm, apex rounded, ripening purple-black; pericarp fleshy; endocarp thin and brittle. **Seeds** endospermic.

Vernacular names. Sarawak—*empala*, *mok* (Iban).

Distribution. Borneo (Sabah and Sarawak) and the Philippines. In Sabah, known from G. Kinabalu, G. Alab, Tenompok and Crocker Ranges (e.g., *Clemens 28986*, *RSNB 939*, *SAN 54207*, *SAN 65047*, *SAN 123235*, and *SAN 132875*). In Sarawak, recorded from Bt. Mersing, G. Dulit, G. Kalulong, G. Mulu, and G. Murut (e.g., *S 22172*, *S 22516* and *S 37066*).

Ecology. Common in lower and upper montane mossy forest at altitudes above 1500 m, particularly on ridges and summits where the trees are shrubby and the leaves are thickly coriaceous. At lower altitudes, the leaves are larger and less coriaceous. Occasionally also occurs in *kerangas* forest (e.g., in Tenompok, Sabah).

4. **SCHREBERA** Roxb.

(J.C.D. van Schreber, 1739–1810, a German botanist)

Corom. Pl. 2 (1799) 1, 101; Hooker *f.*, Fl. Brit. Ind. 3 (1882) 604.

Trees or *shrubs*. **Twigs** terete. **Leaves** *imparipinnate*, *3–7-foliolate*; leaflets chartaceous to subcoriaceous, margin entire. **Inflorescences** terminal or axillary, corymbose-paniculate. **Flowers** bisexual, *to 20 mm long*, heterostylous, white or yellow, with dense brown or purple hairs inside; calyx tubular to campanulate, irregularly 4–8-lobed or obscurely dentate; corolla salverform, tomentose on both sides, tube cylindric, often with dense beard of hairs inside, *lobes* (*4–*)*6–8*, imbricate in bud, spreading at anthesis, apex obtuse; stamens attached near top and included in corolla tube, filaments short, anthers ovate; ovary 2-loculed, style long and filiform, stigma shortly 2-lobed; ovules 4 per locule, pendulous. **Fruits** capsules, pendulous, *thick-walled and woody*, laterally compressed, ellipsoid to obovoid, *splitting into 2 concave parts each with a perpendicular central wall*. **Seeds** 4–8, pendulous, *winged apically and laterally*, endosperm thin or absent.

Distribution. A genus with 27 species, distributed in tropical Africa (24 species), Peru (1 species), India to N Thailand (1 species), and Borneo (1 species).

Schrebera kusnotoi Kosterm. Fig. 9.

(Kusnoto Setyodiwiryo, 1911–1981, the first Indonesian Director of the Bogor Botanic Gardens)

Reinwardtia 2 (1953) 360; Meijer, Bot. Bull. Herb. Sandakan 10 (1968) 185. **Type:** *Kostermans 5989*, Borneo, Kalimantan, E Kutei, Sangkulirang, G. Sekrat (holotype BO; isotypes K, L, SING).

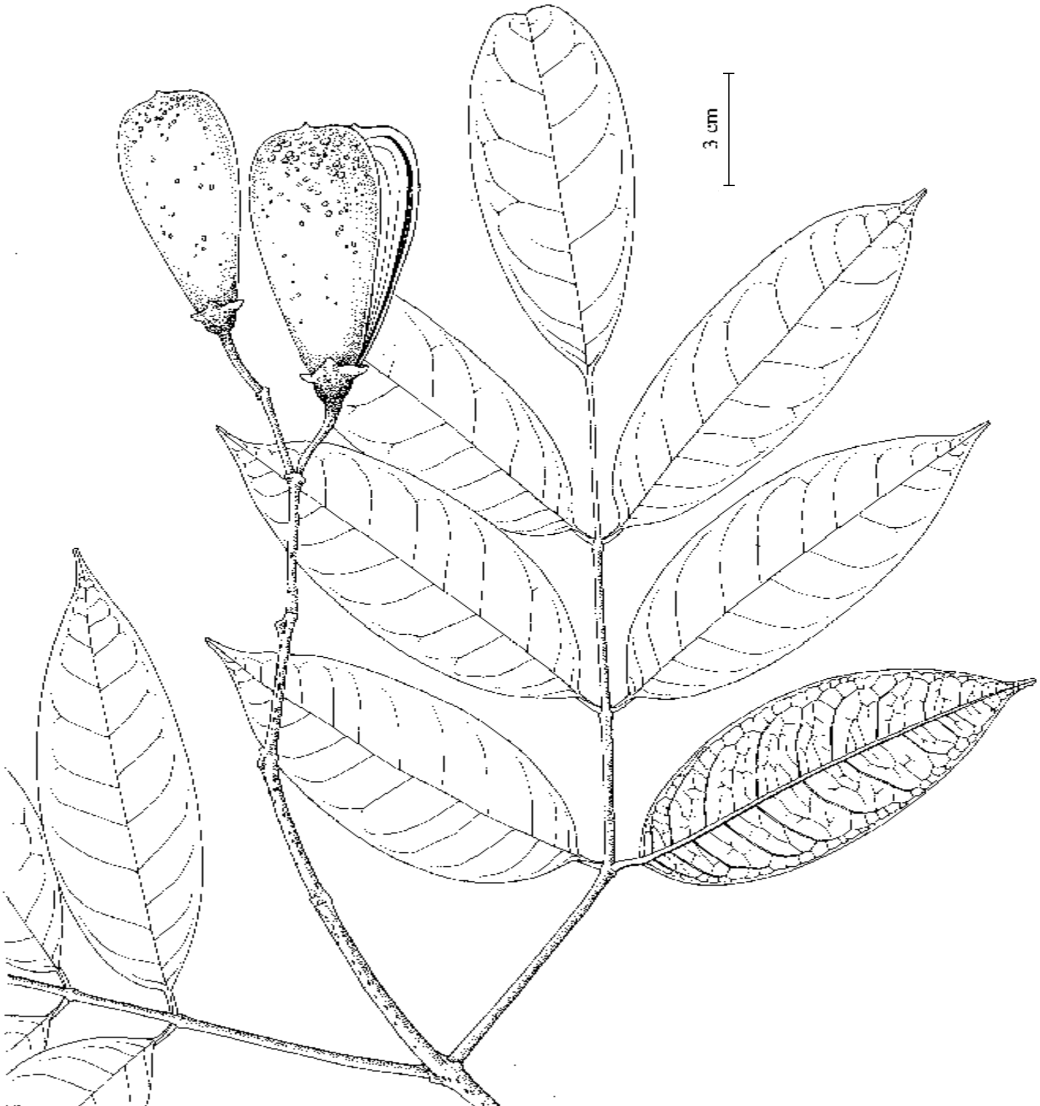

Fig. 9. *Schrebera kusnotoi.* Fruiting leafy twig. (All from *SAN 64150.*)

Tree, 24–45 m tall, to 90 cm diameter; buttresses 1–3 m high. **Bark** whitish or grey, scaling off profusely into 5-cm-long, subquadrangular, irregular flakes. **Sapwood** pale brown; heartwood blackish with paler streaks. **Twigs** thick, flattened at nodes, with prominent leaf scars. **Leaves** clustered at end of twigs, 2–3-jugate; petiole 5–8 cm long, slender but thickened at point of insertion; rachis 8–14 cm long, grooved above. **Leaflets** with petiolules *c.* 1 cm long, slender, grooved above; blade subcoriaceous and glossy above, lanceolate, 6–10 × 1.5–4.5 cm, base acute, usually oblique and decurrent, apex acute to caudate-acuminate with slender acumen *c.* 0.5 cm long; midrib impressed above; lateral veins 8–10 pairs; intercostal veins forming prominent reticulation on both surfaces, glabrous. **Inflorescences** axillary and terminal, to 10 cm long; peduncle stout and glabrous; bracts foliaceous, lanceolate, 5–5 × 1.5–2 mm at base, decreasing in size toward apex, persistent, glabrous or minutely pubescent. **Flowers:** pedicel to 12 mm long; calyx urceolate, *c.* 5–9 mm long, coriaceous, lobes 5–6, ovate, *c.* 2–3 mm long; corolla white, tube almost cylindric, 7–20 mm long and *c.* 3 mm diameter, minutely and sparsely pilose, lobes 7, obovate-suborbicular, 2–5 × 2–3 mm, stamens with filaments attached to corolla tube, anthers enclosed within the tube, *c.* 1.5 mm long; ovary subglobose, *c.* 1 mm long, style glabrous, stigma large. **Fruits** obovoid, 5–7 cm long, *c.* 1 cm wide at base, expanding to 3.3–2.7 cm long and *c.* 1.5 cm wide toward the flat-topped, minutely apiculate apex; endocarp *c.* 3 mm wide; stalk *c.* 2 cm long. **Seeds** curved, *c.* 1.8 cm long, with apically positioned papery wing *c.* 4 cm long, filling the fruit cavity below.

Distribution. Endemic to Borneo (Sabah and NE Kalimantan). In Sabah, known by two collections from Ranau district (*SAN 20658* and *SAN 64150*), and in Kalimantan recorded from Sangkulirang district (e.g., *bb. 7974* and *Kostermans 5989*).

Ecology. In lowland and hill mixed dipterocarp forest and limestone hill forest, at altitudes to 1600 m.

PROTEACEAE

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Merrill, EB (1921) 235; Ridley, FMP 3 (1924) 140; Masamune, EPB (1942) 257; Sleumer, Blumea 8 (1955) 2, FM 1, 5 (1955) 147; Backer & Bakhuizen *f.*, FJ 1 (1964) 273; Kochummen, TFM 2 (1973) 311; Anderson, CLTS (1980) 288; Cockburn, TS 2 (1980) 75; Ashton, MNDTS 2 (1988) 328; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 291; Turner, Gard. Bull. Sing. 47 (1995) 409; Coode *et al.* (eds.), CLBD (1996) 258; Argent *et al.* (eds.), MNDT-CK 2 (1997) 516.

Trees or shrubs; without buttress. Stipules absent. **Leaves** spiral or in pseudowhorls, sometimes subopposite; blade often dimorphous, unlobed or deeply lobed, margin entire or serrate. **Inflorescences** many-flowered racemes, axillary or borne on leafless older branches; bracts minute, early caducous; bracteoles very small. **Flowers** radially symmetrical or sometimes bilaterally symmetrical, bisexual or unisexual (plants dioecious); buds usually cylindric, straight or curved, more or less widen towards base, with clavate or globular apex; perianth-segments (tepals) 4, valvate, with a distinctly broadened limb, recurved, adhering to each other in the lower portion to various degree; torus flat or oblique; stamens 4, filaments connate with tepals to various degree, sometimes very short, anthers basifixed, 2-loculed, introrse, dehiscing lengthwise, connective often prolonged; disk with 4 free or variously united glands around ovary and alternating with stamens, rarely absent; ovary superior, 1-loculed, sessile or stipitate; style thickened at apex, stigma small, punctiform or discoid, terminal or lateral. **Fruit** a nut or drupe-like, usually indehiscent. **Seeds** 1(–2) per fruit, with fleshy cotyledons.

Distribution. About 60 genera, with *c.* 1300 species. Mostly in the tropics and subtropics, mainly of the southern hemisphere (Africa, C and S America, Asia, Malesia, Australia, New Caledonia, New Hebrides, New Zealand, Fiji, and Samoa). In Sabah and Sarawak, the family is represented by two genera (*Helicia* and *Heliciopsis*) with 20 species. Of these, seven species are endemic to Borneo.

Ecology. In Borneo, species of the Proteaceae are found in primary *kerangas*, mixed dipterocarp to upper montane forests from sea level to 3350 m, on river-banks and ridges but are nowhere abundant. In Australia, pollination appears to be frequently affected by birds, mammals or insects, but observations have not been made in Borneo. The mode of fruit and seed dispersal is little understood.

Uses. Although the timber is attractive, neither *Helicia* nor *Heliciopsis* are harvested commercially. Several species of Australian Proteaceae with showy inflorescences are cultivated in Malaysia as ornamentals, e.g. *Grevillea banksii* R.Br. and *Stenocarpus sinuatus* Endl. Some species produce edible seeds, for instance the Queensland nuts (*Macadamia ternifolia* F.v.M.

and *M. tetraphylla* L.A.S.Johnson), which are imported into Malaysia and other countries. The feathery-leafed *Grevillea robusta* A.Cunn. is used for reafforestation, and extensively planted as a shade tree in tea plantations.

Taxonomy. Sleumer (FM 1, 5 (1955) 150) stated that the family can be divided into two subfamilies, *viz*. the Persoonioideae and Grevilleoideae, with the two genera occurring in Sabah and Sarawak belonging to the latter. The subfam. Grevilleoideae can be segregated into 3 tribes, *viz.* the Grevilleae, Embothriae and Banksiae, with *Helicia* and *Heliciopsis* are included in the Grevilleae.

The two genera found in Sabah and Sarawak are very similar and closely related. *Heliciopsis* was only recognised as a distinct genus in 1955 when Sleumer (*l.c.*) revised the family for the Flora Malesiana. In addition to the characters given in the key, there are consistent differences in wood anatomy and pollen morphology for these two genera.

Notes. Timbers are moderately hard and moderately heavy to heavy, not durable; grain straight; texture slightly coarse and uneven because of broad rays; sapwood susceptible to attack by powderpost beetles, yellowish pink, sharply differentiated from the brown heartwood, and with conspicuous silver figure on quarter sawn surfaces.

Key to genera

Leaves not lobed. Flowers bisexual; stigma punctiform, terminal, stigmatic surface without cleft; ovules anatropous. Fruit pericarp not differentiated into distinct layers; mesocarp without a distinct fibrous tissue..**1. Helicia**

Leaves of two forms, unlobed and deeply lobed. Flowers unisexual, plants dioecious; stigma (in female flowers) discoid, lateral, stigmatic surface with distinct cleft; pistillode without stigmatic surface; ovules orthotropous. Fruit pericarp differentiated into three distinct layers; mesocarp with a distinct fibrous tissue...................................**2. Heliciopsis**

1. **HELICIA** Lour.

(Greek, *helix* = a coil; referring to the twisted perianth-segments at anthesis)

kajo tata (Berawan), *kayo talat* (Kayan), *kayu tatah* (Kenyah), *kayu tatat* (Punan), *palih* (Dusun and Iban), *palis* (Iban), *pasis* (Bidayuh)

Fl. Cochinch. 1 (1790) 83; Gamble, J. As. Soc. Beng. 75, 2 (1914) 340; Merrill, EB (1921) 235; Ridley, FMP 3 (1924) 140; Masamune, EPB (1942) 257; Sleumer, Blumea 8 (1955) 7, FM 1, 5 (1955) 164; Backer & Bakhuizen *f.*, FJ 1 (1964) 274; Kochummen, TFM 2 (1973) 313; Anderson, CLTS (1980) 288; Cockburn, TS 2 (1980) 75; Ashton, MNDTS 2 (1988) 330; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 291; Kessler & Sidiyasa, TBSA-EK (1994) 195; Argent *et al.* (eds.), MNDT-CK 2 (1997) 516; PROSEA 5, 3 (1998) 284; Chung, J. Trop. For. Sci. 13 (2001) 536. **Synonym:** *Helittophyllum* Blume, Bijdr. Fl. Ned. Ind. (1825) 652.

Small to medium-sized trees, rarely shrubs. **Leaves** mostly spiral, rarely subopposite or 3–4-verticillate, sessile or petiolate, *unlobed*, margins entire or serrate, intercostal venation reticulate. **Inflorescences** racemose, many-flowered, axillary or borne on leafless older branches, rarely subterminal; bracts small, ovate-acuminate to subulate, subpersistent or caducous; bracteoles minute. **Flowers** *bisexual*; pedicels mostly in pairs or solitary, free or partially connate at base, rarely entirely connate; perianth-tube straight, slender, with a clavate to subglobose limb, somewhat swollen at base, limb straight, segments 4, becoming free and twisted at anthesis; stamens 4, nearly sessile, inserted at the inner base of perianth limb, anthers oblong, connective apiculate; ovary ovoid or globose, sessile, style filiform, *stigma punctiform*, *terminal*, *stigmatic surface* glandular, *without cleft*; *ovules* 2, *anatropous*, inserted at the inner base of ovary or laterally attached to the wall on ventral suture; disk-glands free or connate into a cup. **Fruits** nut- or drupe-like, ellipsoid to subglobose or ovoid to depressed ovoid or obovoid, mostly indehiscent, sometimes very tardily splitting irregularly along ventral suture when dry; pericarp mostly thickly coriaceous and rather hard when dry, *exocarp and endocarp usually not clearly differentiated*, *mesocarp without fibrous tissue*. **Seeds** 1(–2, not in Borneo), subglobose or hemispheric; testa thin; cotyledons fleshy, rugulose in the upper part.

Distribution. About 90 species in S India, Sri Lanka, SE Asia, SE China, Hainan, S Japan, Taiwan, throughout Malesia, Melanesia, and NE Australia. In Sabah and Sarawak, the genus is represented by 13 species, of which 5 species are Bornean endemics.

Ecology. In lowland to montane rain forests, from sea level to 2000(–3350) m altitude. Some (e.g., *H. robusta*) prefer habitats along streams but others (e.g., *H. excelsa*) are found on hill tops or ridges.

Uses. As the species do not reach timber size, *Helicia* is of no commercial importance. The nicely figured and hard wood is used for superior joinery, high class furniture, cabinet work and interior finish, flooring and also (but rarely) for axe handles, house building and mining poles. In Peninsular Malaysia, *H. petiolaris* is occasionally planted for ornamental purposes. In Java, young shoots of *H. robusta* and *H. serrata* are eaten raw as a vegetable (PROSEA, 1998).

Taxonomy. Sleumer (FM 1, 5 (1955) 166) subdivided the genus into 3 sections, *viz.* sect. *Macadamiopsis* Sleumer, characterised by perulate inflorescences; sect. *Cyanocarpus* (Bailey) Sleumer, characterised by drupes with a distinct hard endocarp; and sect. *Helicia* (Lour.) Sleumer with undifferentiated pericarp.

Key to *Helicia* species

1. Leaves sessile or subsessile; base rounded, truncate or subcordate, not decurrent.........2
   Leaves with a distinct petiole; base attenuate or cuneate, decurrent.......................5

2. Young twigs terete. Leaf margin serrate, sometimes subentire with some sharp or obtuse teeth on each side in the upper part. Pericarp with 6 distinct obtuse vertical ribs..**8. H. robusta**
   Young twigs subangular or angular. Leaf margin entire or occasionally with 1–3 minute glandular teeth on both sides. Pericarp smooth................................3

3. Leaves thickly coriaceous, shining above when dry. Inflorescences, pedicels and perianths hairy; disk-glands connate at base only. Fruits subglobose.. **4. H. maxwelliana**
   Leaves chartaceous to thinly coriaceous, on drying not shining above. Inflorescences, pedicels and perianths glabrous; disk-glands connate into a crenulate ring. Fruits ellipsoid..4

4. Leaves oblanceolate or obovate-oblong. Pedicels distinctly wrinkled; limb of perianth 1.5–2 mm diameter; anthers 2.5–3 mm long. Fruits smaller, 0.8–1.7 × 0.6–1.1 cm, black when dry, not apiculate or stiped; pericarp *c.* 0.5 mm thick.. **5. H. obovata**
   Leaves broadly elliptic or obovate. Pedicels with smooth surface; limb of perianth 0.8–1.2 mm diameter; anthers 1–1.5 mm long. Fruits larger, 4–4.5 × 2.4–2.7 cm, chesnut-brown when dry, shortly apiculate and stiped; pericarp 2.5–3 mm thick.. **11. H. sessilifolia**

5. Leaves smaller, 5–10 × 2.5–5 cm, thickly coriaceous; apex emarginate or obtuse.. **12. H. symplocoides**
   Leaves generally larger, (5–)10–20(–30) × (2.5–)3–8(–13) cm; chartaceous to thinly coriaceous; apex acute or acuminate..6

6. Ovary glabrous..7
   Ovary hairy..10

7. Petiole slender, to 1 mm thick. Pedicels with membranaceous wing on each side; disk-glands free.. **7. H. pterygota**
   Petiole stout, 1.5–3 mm thick. Pedicels not winged; disk-glands connate into a crenulate ring.. 8

8. Leaves subopposite or verticillate; margin recurved when dry. Found exclusively in montane forest (Mt. Kinabalu), at *c.* 3350 m altitude........................... **13. H. sp. A**
   Leaves spiral; margin entire, plane when dry. Found in lowland mixed dipterocarp to lower montane forests, at altitudes to 2100 m..9

9. Leaves greenish or yellowish brown or sometimes pale brown when dry; petiole 0.4–0.8(–1) cm long, 1.5–2 mm thick, greyish brown, bright or deep brown when dry. Rachis 1–1.5(–2) mm diameter. Limb of perianth 1–1.5 mm diameter.................................. **1. H. attenuata**
   Leaves olive-green to grey-brown above and dull or dark brown below when dry; petiole (1–)1.5–2.5(–4) cm long, 2–3 mm thick, dark green to dull brown or black when dry. Rachis (2–)2.5–3(–4) mm diameter. Limb of perianth 2–2.5 mm diameter..... .... **6. H. petiolaris**

10. Petiole, inflorescences, perianths, and fruits reddish-brown tomentose. Fruits brown to rusty brown when dry; pericarp 2–2.5 mm thick.................... **3. H. fuscotomentosa**
    Petiole, inflorescences, perianths, and fruits glabrous or glabrescent. Fruits dark brown to black when dry; pericarp to 1.5 mm thick..11

11. Leaves narrowly elliptic, glaucous below, margin recurved when dry; petiole more than 1.5 cm long.. **9. H. rufescens**

Leaves elliptic, oblong, oblanceolate or obovate, not glaucous below, margin not recurved when dry; petiole less than 1.5 cm long..12

12. Leaf margin serrate, rarely subserrate or entire. Inflorescences axillary in axils of lower leaves or borne on leafless older branches..............................**10. H. serrata**
Leaf margin always entire. Inflorescences axillary in axils of upper leaves, sometimes subterminal...**2. H. excelsa**

1. **Helicia attenuata** (Jack) Blume

(Latin, *attenuatus* = drawn out; referring to the leaf base)

Ann. Sci. Nat. 2, 1 (1834) 216; Gamble *l.c.* (1914) 341; Ridley *l.c.* (1924) 141; Merrill, J. Arn. Arb. 33 (1952) 243; Sleumer, Blumea 8 (1955) 61, FM 1, 5 (1955) 186; Backer & Bakhuizen *f. l.c.* 275; Kochummen, TFM 2 (1973) 313; Anderson *l.c.* 288; Cockburn *l.c.* 76; Ashton *l.c.* 330; Whitmore, Tantra & Sutisna *l.c.* 291; Turner, Gard. Bull. Sing. 47 (1995) 409; Coode *et al.* (eds.), CLBD (1996) 258; PROSEA *l.c.* 285. **Basionym:** *Roupala* (“*Rhopala*”) *attenuata* Jack, Mal. Misc. 1, 5 (1821) 10. **Type:** *Jack*, *Herb. Wallich 1040.1*, Peninsular Malaysia, Penang (holotype K!; isotype BM!). **Synonyms:** *Roupala moluccana auct. non* R.Br., *nec* Jack: Roxburgh, Fl. Ind. ed. Carey & Wallich 1 (1820) 364; *H. oblongifolia* Benn. *in* J. Bennett & R. Brown, Pl. Jav. Rar. (1838) 83; *H. bennettiana* Miq., Fl. Ind. Bat. 1, 1 (1858) 984; *H. sumatrana* Miq., Fl. Ind. Bat., Suppl. 1 (1860) 148, 364; *Finschia sumatrana* Miq. *ex* Boerl., Handl. 3, 1 (1900) 151; *H. suffruticosa* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 171; *H. lanceolata auct. non* Koord. & Valeton: Baker *f.*, J. Bot. 63 (1925) Suppl. 89; *H. kingiana auct. non* Prain: Merrill, Pap. Mich. Acad. Sci. 24 (1939) 67.

Shrub or small tree to 15 m tall, 30 cm diameter. **Bark** dark brown, cracked or scaly; inner bark orange-yellow, granular. **Sapwood** yellow. **Twigs** terete, light brown, glabrous. **Leaves** *spiral*, *chartaceous* to *thinly coriaceous*, *glabrous*, *greenish* or *yellowish brown or sometimes pale brown when dry*, *not shining* above; oblong or elliptic-oblong, rarely oblanceolate or obovate, *9–25*(*–30*) × *3–8*(*–11*) *cm*, *base cuneate* or *attenuate*, *decurrent*, *margin entire*, *plane*, *apex acute* or *acuminate*; midrib prominent on both surfaces; lateral veins 7–9(–10) pairs, curving and joining near leaf margin, prominent below, slightly raised above, intermediate veins sometimes conspicuous; intercostal venation visible on both surfaces; *petiole 0.4–0.8*(*–1*) *cm long*, *1.5–2 mm thick*, swollen and wrinkled at base, *greyish brown*, *bright* or *deep brown when dry*, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary, 12–18(–25) cm long, laxly flowered except for 1.5–3 cm from base; *rachis* terete, *1–1.5*(*–2*) *mm diameter*, glabrous; bracts subulate, minute, to 1 mm long, glabrous. **Flowers:** *pedicels* glabrous, 4–5 mm long, *not winged*, mostly in pairs, connate to about 1.5–2.5 mm from base; perianth 10–20(–22) mm long, glabrous, *limb* ellipsoid, *1–1.5 mm diameter*; anthers 1.5–2(–2.5) mm long; *ovary* narrowly ovoid, *glabrous*; *disk-glands* subtruncate, nearly entirely *connate into a crenulate ring*. **Fruits** broadly ellipsoid or subglobose, 3–4(–5) × (2–)2.5–3(–3.5) cm, slightly asymmetric, glabrous, dull brown to dirty brown when dry, shortly apiculate, tip 1–2 mm long, at base contracted into a short stipe of 2–3 mm long, or subglobose, sessile and non-apiculate; pericarp smooth, 1.5–2 mm thick; stalks 4–5(–8) mm long, 2–2.5(–3) mm thick, persistent.

Vernacular name. Sarawak—*katjang* (Iban).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, and Bali. In Sabah (e.g., *SAN 46172*, *SAN 79157*, *SAN 91252*, *SAN 123776*, and *SAN 128355*) and Sarawak (e.g., *S 18481*, *S 28981*, *S 36365*, *S 41258*, and *S 53933*), common and widespread. Also occurs in Brunei (e.g., *Dransfield JD 7163*) and Kalimantan (e.g., *Amdjah 281*, *bb. 11097* and *Jaheri 1092*).

Ecology. In lowland mixed dipterocarp and lower montane forests at altitudes to 1700 m, along streams, on hill slopes and mountain ridges.

2. **Helicia excelsa** (Roxb.) Blume

(Latin, *excelsus* = lofty; referring to its outstanding growth habit)

Ann. Sci. Nat. 2, 1 (1834) 219; Gamble *l.c.* (1914) 346; Merrill, J. Str. Br. Roy. As. Soc. 85 (1922) 168, PEB (1929) 53; Ridley *l.c.* (1924) 143; Masamune *l.c.* 257; Sleumer, Blumea 8 (1955) 36, FM 1, 5 (1955) 174; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 288; Cockburn *l.c.* 76; Ashton *l.c.* 331; Whitmore, Tantra & Sutisna *l.c.* 291; Turner *l.c.* 409; Argent *et al.* (eds.) *l.c.* 516; PROSEA *l.c.* 285. **Basionym:** *Roupala* ("*Rhopala*") *excelsa* Roxb., Fl. Ind. ed. Carey & Wallich 1 (1820) 363. **Type:** *Roxburgh s.n.*, India, E Bengal, Chittagong (holotype BM!). **Synonyms:** *Helicia salicifolia* Presl., Epim. (1851) 247; *Alseodaphne crassipes* Hook.*f.*, Fl. Br. Ind. 5 (1886) 146; *H. oblanceolata* Merr., Pap. Mich. Acad. Sci. 24 (1939) 67.

Small to medium-sized tree to 20 m tall, 25 cm diameter. **Bark** dark grey to blackish, smooth; inner bark pale yellow to ochre-brown. **Sapwood** pale yellow. **Twigs** terete, greyish yellow, reddish-brown tomentose at tips, becoming glabrescent and finally glabrous. **Leaves** spiral, *chartaceous* to *thinly coriaceous*, greenish to yellowish green when dry, not shining, reddish-brown tomentose on both surfaces when very young, soon-glabrescent or glabrous; *narrowly oblong*, *oblanceolate*, or *obovate-oblong*, (*6–*)*10–17*(*–26*) × (*2.5–*)*3–5*(*–7*) *cm*, smaller at high elevations, *base cuneate and decurrent*, *margin entire*, *apex abruptly acuminate* or *subacute*; midrib slightly raised above, distinctly so below; lateral veins (6–) 7–8(–10) pairs, curving and joining near leaf margin, slightly prominent on both surfaces; intercostal venation prominently raised on both surfaces; *petiole 0.5–1*(*–1.5*) *cm long*, 1–1.5 mm thick, swollen and wrinkled at base, yellowish grey when dry, reddish-brown tomentose when very young, soon-glabrescent and *finally glabrous*. **Inflorescences** *axillary in axils of upper leaves*, *sometimes subterminal*, solitary or in clusters of 2–3, (5–)7–12(–15) cm long, densely flowered except for 1–1.5 cm from base; rachis terete, 1–1.5 mm diameter, initially densely reddish-brown tomentose, *glabrescent* but never entirely glabrous; bracts ovate-lanceolate, (1.5–)2–3 mm long, reddish-brown tomentose. **Flowers:** pedicels 2–3(–4) mm long, not winged, mostly in pairs, free or connate to 1–1.5(–2) mm from base, reddish-brown tomentose; perianth (5–)6–8 mm long, initially reddish-brown tomentose, *glabrescent*, limb ellipsoid, *c.* 1 mm diameter; anthers *c.* 1.5 mm long; *ovary* oblong, *reddish-brown tomentose*; disk-glands free, nearly rounded or truncate. **Fruits** ellipsoid, ovoid or obovoid, 1–2(–3) × 0.8–1.3(–1.5) cm, asymmetric, *glabrous*, *black when dry*, shortly or not apiculate, tip 0.5–1 mm long, without stipe; *pericarp* smooth, *0.2–1 mm thick*; stalks 2.5–3(–6) mm long, 1–1.5(–2) mm thick, persistent.

Vernacular names. Sabah—*pasir-pasir* (Sandakan). Sarawak—*luang* (Kelabit).

Distribution. E Bengal, Burma, Indo-China, Thailand, Peninsular Malaysia, Sumatra, and Borneo. In Sabah (e.g., *Clemens 28292*, *RSNB 4169*, *SAN 74508*, *SAN 109188*, and *SAN 117132*) and Sarawak (e.g., *Nooteboom & Chai 2174*, *S 8428*, *S 24938*, and *S 48444*), common and known from many districts/divisions. Also recorded from C Kalimantan (e.g., *Hallier 2385*, *bb. 7917* and *bb. 15623*).

Ecology. In swamp, mixed dipterocarp and lower montane forests, at altitudes to 1700 m. On sandy soils and ridges.

Uses. The timber is locally used for house construction and mining poles.

3. **Helicia fuscotomentosa** Suesseng. Fig. 1.

(Latin, *fusco-* = dark brown, *tomentosus* = densely pubescent with matted woolly or short hairs; referring to the indumentum of young parts)

Mitt. Bot. Staatssamml. München 2 (1950) 61; Sleumer, Blumea 8 (1955) 24, FM 5, 1 (1955) 170; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 331; Whitmore, Tantra & Sutisna *l.c.* 292; Coode *et al.* (eds.) *l.c.* 258. **Type:** *Clemens 28724*, Borneo, Sabah, Mt. Kinabalu, Tenompok (holotype M; isotypes A, B, BO!, BM, K!, L, NY).

Small or medium-sized tree to 25 m tall, 30 cm diameter. **Bark** mottled grey and black, smooth; inner bark orange-brown, invaginating into sapwood. **Sapwood** dark yellow with harder radial pale striations. **Twigs** terete, blackish grey, densely and persistently dark reddish-brown tomentose at tips, greyish to yellowish tomentose in older parts, finally glabrescent. **Leaves** spiral, *thinly coriaceous*, yellowish green to yellowish olivaceous when dry, not shining, young ones reddish-brown tomentose on both surfaces, soon-glabrescent and mostly glabrous except midrib and petiole; elliptic to oblong-elliptic, rarely obovate, (*5–*)*7–18*(*–25*) × (*2.5–*)*3–9*(*–11*) *cm*, smaller at high elevation, *base cuneate*, *decurrent*, margin entire, *apex abruptly acuminate* to *subacute*; midrib slightly raised above, very distinctly so below; lateral veins (6–)7–11(–12) pairs, curved upwards, not clearly joining near leaf margin, prominent on both surfaces; intercostal venation raised on both surfaces; *petiole 1–2.5*(*–3*) *cm long*, 1–3 mm thick, swollen and smooth at base, grey or yellowish brown when dry, *reddish-brown tomentose*. **Inflorescences** axillary or borne on leafless older branches, solitary, 6–13(–14) cm long, densely flowered except for 1–1.5 cm from base; rachis terete, 1–2 mm diameter, *densely reddish-brown tomentose*; bracts ovate-acuminate, 1–1.5 mm long. **Flowers:** pedicels 1–2(–3) mm long, not winged, mostly in pairs, more or less connate, reddish-brown tomentose; perianth 10–12 mm long, *densely reddish-brown tomentose* externally, limb clavate, 2–2.5 mm diameter; anthers *c.* 2 mm long; *ovary* globose, *reddish-brown tomentose*; disk-glands broadly triangular, free, spaced. **Fruits** elongate-ellipsoid, ovoid or subglobose, (2.5–)3–3.5 × (2–)2.5–3 cm, asymmetric, *reddish-brown tomentose*, shortly apiculate, tip 1–2 mm long, at base shortly contracted into a short stipe of *c.* 1(–4) mm long; *pericarp 2–2.5 mm thick*, smooth or rarely with two tiny vertical ribs; stalks (5–)7–9 mm long, 4–5 mm thick, persistent.

Distribution. Endemic to Borneo. In Sabah, known from Beaufort, Ranau, Keningau, and Sandakan districts (e.g., *Chew & Corner RSNB 4102*, *Clemens 28724*, *SAN 31127*, *SAN 60792*, and *SAN 83845*). In Sarawak, recorded from Lundu, Kuching, Bintulu, Miri, Kapit, and Limbang divisions (e.g., *S 12782*, *S 26179*, *S 36859*, *S 47168*, and *S 52966*). Also occurs in Brunei (e.g., *BRUN 5504*, *BRUN 15262* and *BRUN 17634*) and Kalimantan (e.g., *Endert 3890* and *bb. 28336*).

Ecology. Frequent in lowland mixed dipterocarp and montane forests, at altitudes to 2000 m, especially on sandstone ridges.

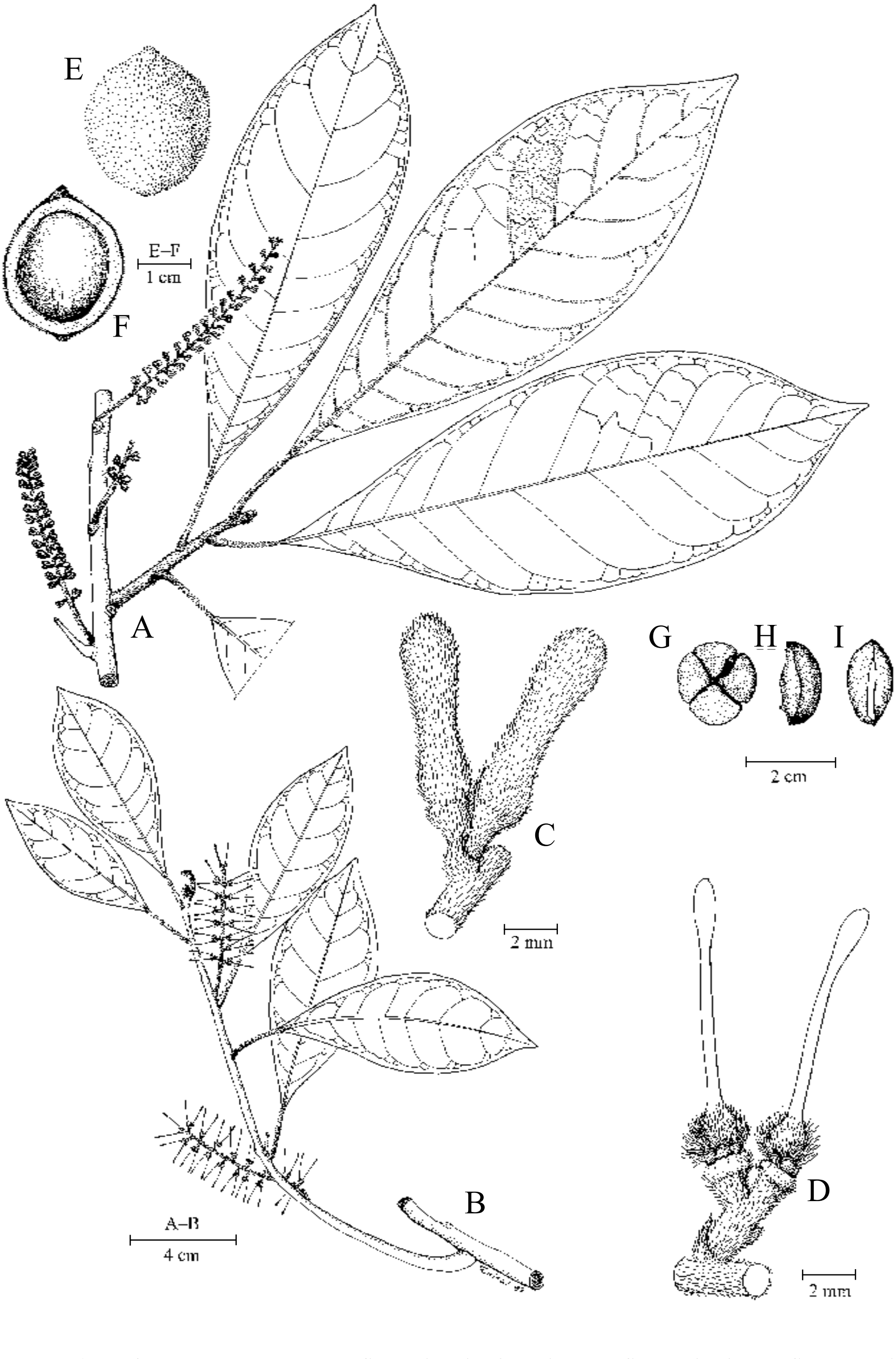

Fig. 1. *Helicia fuscotomentosa.* A–B, flowering leafy twigs; C, flower buds; D, flowers with perianths removed; E, fruit; F, longitudinal section of fruit; G, top view of seed; H, side view of one cotyledon; I, radial view of one cotyledon. (A from *S 12782*, B and D from *SAN 51362*, C from *RSNB 1841*, E–I from *S 35995*.)

4. **Helicia maxwelliana** Gibbs Fig. 2.

(D.R. Maxwell, officer of the North Borneo Company who accompanied Gibbs to climb Mt. Kinabalu in 1910)

J. Linn. Soc. Bot. 42 (1914) 131; Merrill *l.c.* (1921) 235; Masamune *l.c.* 257; Sleumer, Blumea 8 (1955) 42, FM 1, 5 (1995) 178; Cockburn *l.c.* 76; Whitmore, Tantra & Sutisna *l.c.* 292. **Type:** *Gibbs 3137*, Borneo, Sabah, Mt. Kinabalu, Marai Parai spur (holotype BM!).

Treelet to 3 m tall. **Twigs** dark brown, *young parts subangular*, laxly covered by short appressed, pale reddish-brown hairs, older ones terete, glabrous. **Leaves** spiral, *thickly coriaceous*, olive-green to dark brown when dry, *shining above*, glabrous; broadly elliptic, obovate-oblong, 15–23 × (7–)8–11 cm, *base subcordate* or *rounded*, *margin entire* or *occasionally with 1–3 minute glandular teeth on both sides*, slightly recurved, apex broadly attenuate to rounded; midrib slightly prominent above, very stout and prominent below; lateral veins (8–)9–10 pairs, curving and joining near leaf margin, *distinctly raised above*, prominent below; *intercostal venation prominent above*, conspicuous below; petiole 0.3–0.5 cm long, 3–4(–6) mm thick, swollen or wrinkled at base, dark brown when dry, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary, 10–14 cm long, densely flowered except for 1 cm from base; rachis terete, *c.* 2 mm diameter, *appressed reddish-brown hairy*; bracts ovate-acuminate, 1–1.5 mm long, densely reddish-brown hairy. **Flowers:** pedicels 3–4(–5) mm long, not winged, mostly in pairs or in fours, free or connate at base, *densely appressed reddish-brown hairy*; perianth 12–13(–14) mm long, *sparsely reddish-brown hairy*, limb clavate, *c.* 1.5 mm diameter; anthers *c.* 2 mm long; ovary glabrous; disk-glands ovate, *connate at base*. **Fruits** *subglobose*, 2–2.5 × 1.8–2.2 cm, oblique, glabrous, black when dry, shortly apiculate, tip 1–1.5 mm long, at base contracted into a short stipe of *c.* 1.5 mm long; *pericarp smooth*, *c.* 2 mm thick.

Distribution. Endemic to Borneo (Sabah). Rare and known only from Mt. Kinabalu (e.g., *Clemens 11082*, *Clemens 31898*, *Gibbs 3137*, and *Nais et al. SNP 5164*).

Ecology. Lower montane forest, at 1600–1700 m altitude, on ridge top on ultrabasic soils.

5. **Helicia obovata** Benn. Fig. 3.

(Latin, *ob-* = reversed, *ovatus* = egg-shaped; the shape of the leaf)

In J. Bennett & R. Brown, Pl. Jav. Rar. (1838) 83; Chung *l.c.* (2001) 542. **Type:** *Horsfield s.n.*, Java (holotype BM!, isotype K). **Synonym:** *Helicia attenuata auct. non* (Jack) Blume: Sleumer, Blumea 8 (1955) 61, FM 1, 5 (1955) 186, *p.p.*, *quoad syn. H. obovata* Benn.

Treelet or small tree, 4–15 m tall, 5–20 cm diameter. **Bark** brownish grey, smooth; inner bark pale yellow. **Sapwood** yellowish. **Twigs** yellowish or greyish brown, *young parts angular*, older parts terete, glabrous. **Leaves** subopposite, *thinly coriaceous*, olive-green on drying, *not shining above*, glabrous; *oblanceolate* or *obovate-oblong*, (13–)16–28(–38) × 6–9.5(–12) cm, *base subcordate*, *nearly auriculate* or *truncate*, *margin entire* or *occasionally with 2–3 minute glandular teeth on both sides*, apex acute; midrib raised above, prominent below; lateral veins (7–)8–11 pairs, curving and joining near leaf margin, *prominent on both surfaces*; intercostal venation *prominent on both surfaces*; *petiole very short*, swollen at base. **Inflorescences** subterminal or axillary, solitary, (16–)18–28 cm long, laxly flowered except for 4–7 cm from base; *rachis* terete, (2–)2.5–3 mm diameter, *glabrous*; bracts ovate-acuminate, 1–1.5 mm long,

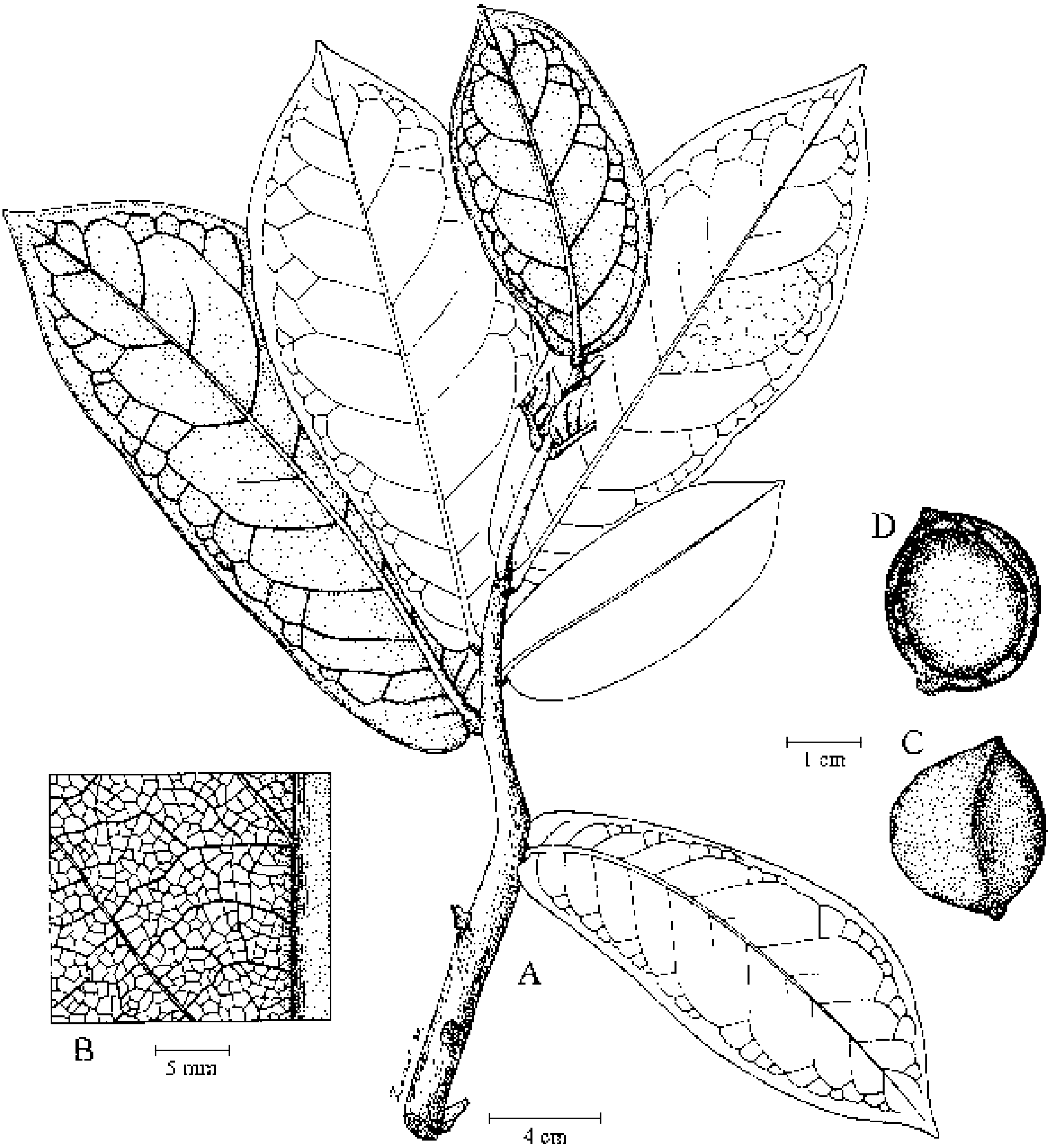

Fig. 2. *Helicia maxwelliana.* A, leafy twig; B, detail of lower leaf surface; C, fruit; D, longitudinal section of fruit. (All from *Nais et al. SNP 5164.*)

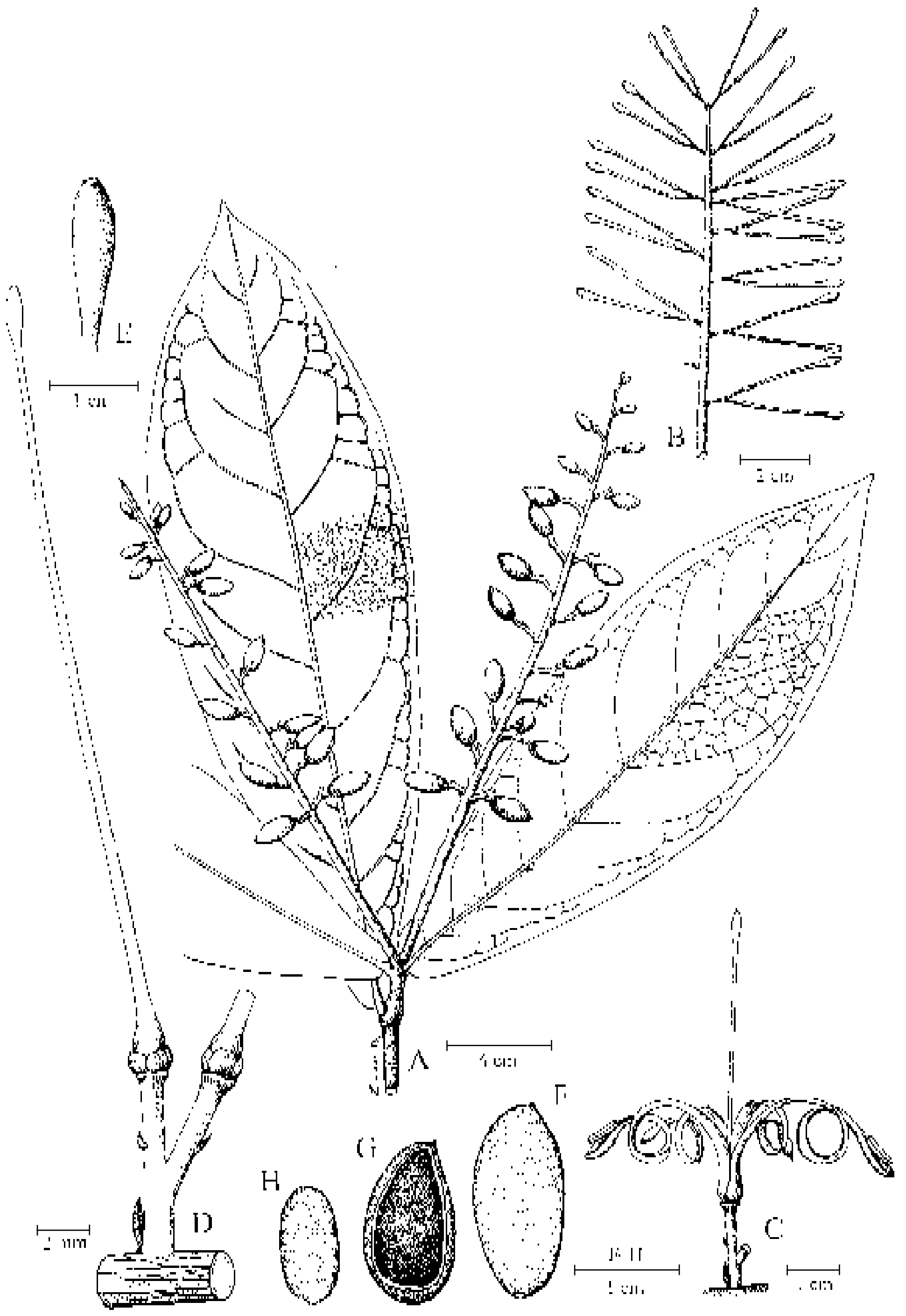

Fig. 3. *Helicia obovata.* A, fruiting leafy twig; B, inflorescence; C, open flower; D, open flowers with perianths removed; E, stigma; F, fruit; G, longitudinal section of fruit; H, lateral view of seed. (A and F–H from *SAN 132690*, B from *SAN 122694*, C–E from *S 52402.*)

glabrous. **Flowers:** *pedicels* 5–8(–9) mm long, *distinctly wrinkled*, mostly in pairs, connate to 2–4 mm from base, *glabrous*; perianth (12–16–)25–28 mm long, *glabrous*, *limb* ellipsoid, *1.5–2 mm diameter*; *anthers 2.5–3 mm long*; ovary ovoid, glabrous; *disk-glands* broadly ovate, *connate into a crenulate ring.* **Fruits** *ellipsoid*, *0.8–1.7 × 0.6–1.1 cm*, slightly asymmetric, glabrous, *black when dry*, *not apiculate or stiped*; *pericarp smooth*, *c. 0.5 mm thick*; stalks 5–6 mm long, 1.5–2 mm thick, persistent.

Distribution. Java and Borneo. In Sabah, common, known from Ranau, Tambunan, Tenom, Keningau, and Kota Belud districts (e.g., *Nooteboom 1316*, *SAN 55813*, *SAN 76827*, *SAN 121704*, and *SAN 122694*). In Sarawak, rare, known only from a single collection, *S 52402*, from Bt. Tebunan, Lawas.

Ecology. Lowland to hill mixed dipterocarp forests, sometimes also found in lower montane forest, at 200–1000(–1500) m altitude.

6. **Helicia petiolaris** Benn. Fig. 4.

(Latin, *petiolaris* = stalked; referring to the leaves)

In J. Bennett & R. Brown, Pl. Jav. Rar. (1838) 84; Merrill *l.c.* (1921) 235; Masamune *l.c.* 257; Sleumer, Blumea 8 (1955) 67, FM 1, 5 (1955) 188; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 332; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; Argent *et al.* (eds.) *l.c.* 516; PROSEA *l.c.* 286; Chung *l.c.* (2001) 542. **Type:** *Jack*, *Herb. Wallich 1041.1*, Peninsular Malaysia, Penang (holotype K!; isotype BM!). **Synonyms:** *Roupala* ("*Rhopala*") *moluccana auct. non* R.Br., *nec* Roxb.: Jack, Mal. Misc. 1 (1820) 10; *Helicia attenuata auct. non* (Jack) Blume: Ridley, J. Fed. Mal. Stat. Mus. 7 (1916) 49; *H. erratica auct. non* Hook.*f.*: Suessenguth *in* Fedde, Rep. 54 (1951) 226, *p.p.*; *H. kingiana* Prain, Kew Bull (1912) 342; *H. obscurinervis* Chatterjee, Kew Bull. (1948) 65; *H. petiolaris* Benn. var. *kingiana* (Prain) Sleumer, Blumea 8 (1955) 67, FM 1, 5 (1955) 188.

Small tree to 15 m tall, 20 cm diameter; sometimes treelets of only 3 m tall and 8 cm diameter may become reproductively matured. **Bark** grey-brown, smooth; inner bark pale brown, with radial lines of fibrous tissue invaginating into the sapwood. **Sapwood** pale yellowish to pale brown. **Twigs:** young parts triangular, older ones terete, greyish brown to dark brown, glabrous. **Leaves** *spiral* or rarely subopposite, *thinly coriaceous*, on drying *olive-green to grey-brown* and shining *above*, *dull or dark brown below*, glabrous; obovate or oblong-obovate, (*9*–)*12–20*(*–24*) × (*4*–)*6–12*(*–13*) *cm*, *base attenuate* to *cuneate* and *slightly decurrent*, *margin entire and plane*, *apex shortly acuminate*, *acute* or *broadly acute*; midrib slightly raised above, prominent below; lateral veins 7–8(–10) pairs, ascending and inarching towards leaf margin and forming intramarginal veins-loops, prominent on both surfaces; intercostal venation raised on both surfaces; *petiole stout*, (*1*–)*1.5–2.5*(*–4*) *cm long*, *2–3 mm thick*, swollen and sometimes wrinkled at base, *dark green* to *dull brown* or *black when dry*, glabrous. **Inflorescences** axillary, solitary, 15–25(–30) cm long, densely flowered near base, blackish when dry; *rachis* terete, (*2*–)*2.5–3*(*–4*) *mm diameter*, with distinct pedicel scars, sparsely hairy with fine pale reddish-brown appressed hairs or glabrous; bracts subulate or ovate acuminate, minute, to 1 mm long, hairy. **Flowers:** *pedicels* 5–6(–8) mm long, *not winged*, in pairs, connate to *c.* 5(–8) mm from base, hairy; perianth (10–)15–22(–25) mm, glabrous, *limb* clavate, *2–2.5 mm diameter*; anthers 2.5–3 mm long; *ovary* narrowly ovoid, *glabrous*; *disk-glands* obtusely ovate, close together, mostly *connate forming a crenate or fimbriate ring.* **Fruits** depressed ovoid, subglobose to broadly ellipsoid, (1.2–)1.5–3.9 × 1.6–4

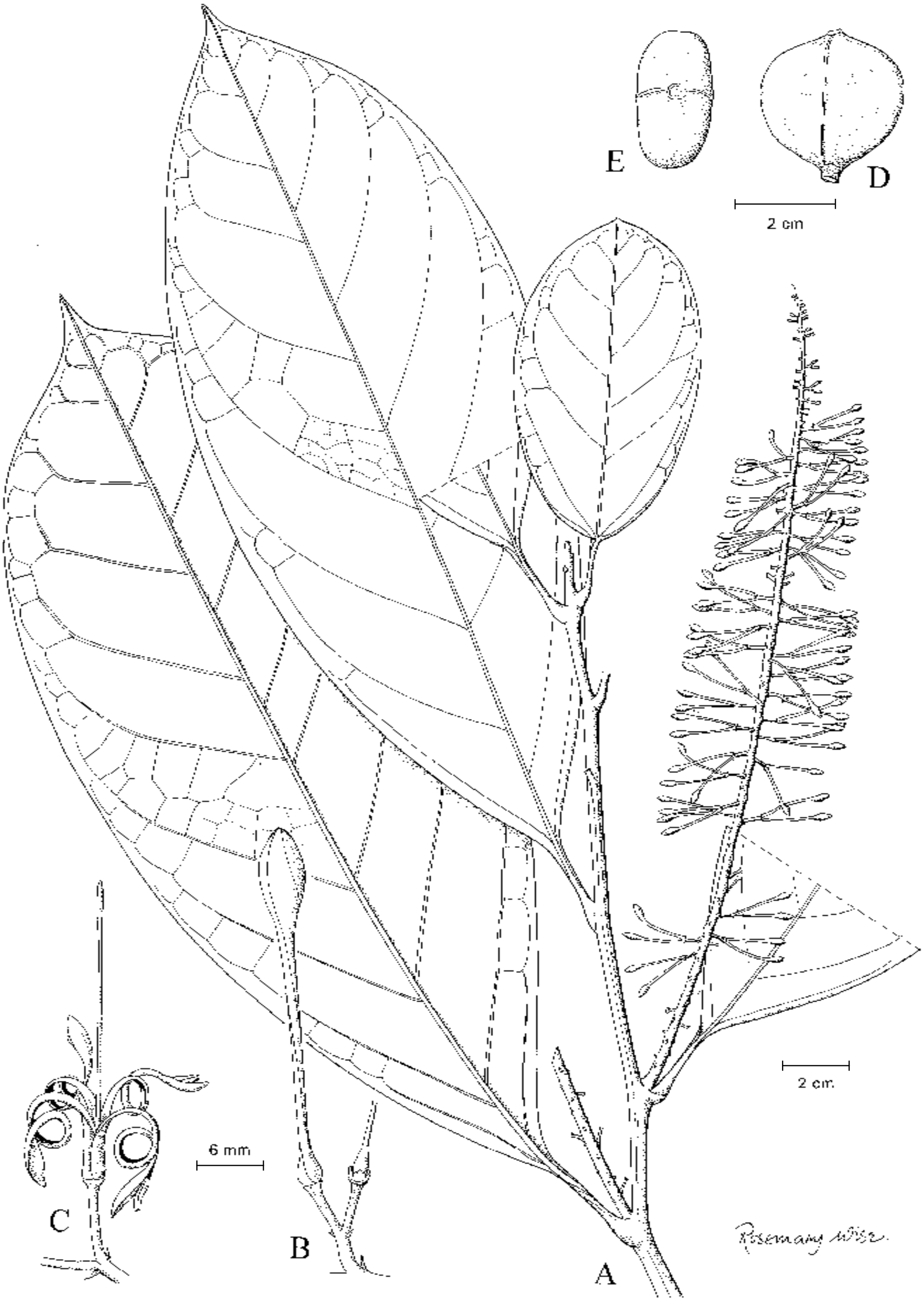

Fig. 4. *Helicia petiolaris.* A, flowering leafy twig; B, flower buds; C, open flower; D, lateral view of fruit; E, dorsal view of fruit. (A–B from *SAN 27726*, C–E from *S 39729*.)

cm, slightly asymmetric, glabrous, black to dark brown when dry, shortly apiculate, tip 1–2 mm long, at base contracted into short stipe of 2–4 mm long, or not apiculate nor stiped in depressed ovoid fruit; pericarp with a tiny vertical rib surrounding fruit, (1–)1.5–3(–4) mm thick; stalks branched or unbranched, (6–)7–10 mm long, (1–)1.5–2.5(–4) mm thick.

Vernacular name. Sabah—*kurungu* (Dusun).

Distribution. Peninsular Malaysia, Singapore and Borneo. Common in Sabah (e.g., *SAN 33635*, *SAN 84792*, *SAN 103091*, *SAN 113142*, and *SAN 118366*), Sarawak (e.g., *S 19086*, *S 25877*, *S 37231*, *S 42990*, and *S 50576*), Brunei (e.g., *BRUN 258*, *S 7849*, *SAN 17494*, *Simpson 2515*, and *Wong WKM 1110*), and W and C Kalimantan (e.g., *Church 196*).

Ecology. Scattered in lowland mixed dipterocarp and *kerangas* forests on leached acid yellow sandy soils and locally abundant in lower montane forest (Mt. Kinabalu, Mt. Mulu and Mt. Pueh), on sandstone ridges to 2100 m altitude.

Uses. The timber is locally used for house-building, but not durable.

7. **Helicia pterygota** Sleumer

(Greek, *pterygotus* = winged; referring to the pedicel)

Blumea 8 (1955) 40, FM 1, 5 (1955) 178; Cockburn *l.c.* 78; Whitmore, Tantra & Sutisna *l.c.* 292. **Type:** *Clemens 28070*, Borneo, Sabah, Mt. Kinabalu, Tenompok jungle (holotype L; isotypes A, BM!, BO!, K!, NY). **Synonym:** *Helicia erratica auct. non* Hook.*f.*: Stapf, FMK (1894) 220, Merrill *l.c.* (1921) 235, Masamune *l.c.* 257.

Shrub or small tree, 1.5–7 m tall, to 6 cm diameter. **Bark** brownish, smooth; inner bark greyish white. **Sapwood** yellowish. **Twigs** terete, greyish or yellowish brown, glabrous. **Leaves** spiral, *chartaceous* to *thinly coriaceous*, light olive-green or light yellowish green when dry, not shining above, glabrous; narrowly elliptic or lanceolate, *(7–)8–12(–17) × 2–4(–5) cm*, *base long-cuneate*, *slightly decurrent*, margin entire or with a few widely spaced teeth in upper part, *apex acute* to *acuminate*; midrib slightly raised above, distinctly prominent below; lateral veins (6–)8–9 pairs, curved upwards near leaf margin and joined with next one to form looped intramarginal veins, raised on both surfaces; intercostal venation slightly prominent on both surfaces; *petiole slender*, *1–1.5 cm long*, *0.5–1 mm thick*, swollen and wrinkled at base, often black when dry, glabrous. **Inflorescences** axillary or subterminal, solitary, (5–) 8.0–17.5 cm long, laxly flowered except for about one fourth from base; rachis angular, 0.5–1 mm diameter, glabrous; bracts ovate-acuminate, membranaceous, *c.* 1 mm long, glabrous. **Flowers:** pedicels (2.5–)3–5(–6) mm long, *mostly with very distinct membranaceous wing on both sides*, mostly in paired, connate to about 1–2.5(–3) mm from base, glabrous; perianth (8–)10–12(–14) mm long, glabrous, limb ellipsoid, *c.* 1 mm diameter; anthers *c.* 1.6 mm long; *ovary* ovoid, *glabrous*; *disk-glands* ovate-oblong, *free*, close together. **Fruits** ellipsoid, 0.8–0.9 × 0.5–0.6 cm, symmetric, glabrous, black when dry, not apiculate and without stipe; pericarp smooth, 0.5–1 mm thick.

Distribution. Endemic to Borneo (Sabah). So far known only from Mt. Kinabalu (e.g., *SAN 28070*, *SAN 57706*, *SAN 60838*, *SAN 125465*, and *SAN 127810*).

Ecology. Hill mixed dipterocarp to lower montane forests, at 1000–1800 m altitude, on ridges.

8. **Helicia robusta** (Roxb.) R.Br. *ex* Wall.

(Latin, *robustus* = stout, coarse; the petiole)

Cat. (1831) 2702; Gamble *l.c.* (1914) 344; Ridley *l.c.* (1924) 142; Sleumer, Blumea 8 (1955) 55, FM 1, 5 (1955) 184; Backer & Bakhuizen *f. l.c.* 275; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 334; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Basionym:** *Roupala robusta* Roxb., Fl. Ind. ed. Carrey & Wall. 1 (1820) 366. **Type:** *Roxburgh s.n.*, India, Assam, Silhet (holotype BM!). **Synonyms:** *Helittophyllum javanicum* Blume, Bijdr. Fl. Ned. Ind. (1826) 652; *Helicia javanica* Blume, Ann. Sci. Nat. 2, 1 (1834) 217; *H. cumingiana* Presl., Epim. (1851) 246, var. *parvifolia* Merr., Philip. J. Sci. 1 (1906) Suppl. 49, En. Philip. 2 (1923) 99; *H. philippinensis* Meisn. *in* DC., Prod. 14 (1856) 441; *H. castaneaefolia* Meisn. *l.c.* 441; *H. attenuata auct. non* (Jack) Blume: Kurz, Nat. Tijd. Ned. Ind. 27 (1864) 172; *H. obovata auct. non* Benn.: Kurz *l.c.* 172; *H. travancorica* Bedd. *ex* Hook.*f.*, Fl. Br. Ind. 5 (1886) 191; *H. oligophlebia* Merr., Philip. J. Sci. 11 (1916) Bot. 6; *H. obovata auct. non* Benn.: Ridley, J. Mal. Br. Roy. As. Soc. 1 (1923) 90.

Distribution. A species consisting of two varieties distributed in India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. In Sabah and Sarawak, only var. *robusta* is known. Another one, var. *integrifolia* (Elmer) Sleumer, occurs in the Philippines.

var. **robusta**

Small tree or shrub to 10(–18) m tall, 6(–10) cm diameter, frequently coppicing. **Bark** greyish white or pale yellow, smooth; inner bark yellow-green. **Sapwood** pale yellow. **Twigs** *terete*, greyish brown, tips reddish-brown hairy with appressed hairs, glabrescent. **Leaves** subopposite, sometimes spiral or verticillate, chartaceous to thinly coriaceous, on drying sometimes dark olivaceous or yellowish green above, brownish or dull brown below, not shining above, initially with appressed hairs below, glabrescent and finally glabrous; obovate-oblong or obovate, 10–25(–30) × 6–12(–15) cm, *base obtuse*, *truncate*, *subcordate*, or sometimes subacute, *not decurrent*, *margin* regularly and coarsely *serrate*, *sometimes subentire with some sharp or obtuse teeth on each side in upper part*, apex acuminate; midrib prominent on both surfaces; lateral veins (7–)10–12(–13) pairs, curved upwards and joined near leaf margin, prominent on both surfaces; intercostal venation faintly visible on both surfaces; petiole very short, to 0.5 cm long, 2–4 mm thick, swollen and wrinkled at base, greyish or dark brown when dry, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary or rarely in pairs, 12–25(–30) cm long, densely flowered except for (1–)1.5–2.5 cm from base; rachis subangular, 1.5–2 mm diameter, densely reddish-brown hairy, becoming sparsely hairy but never entirely glabrous; bracts ovate, 1–1.5 mm long, reddish-brown hairy, soon-glabrescent. **Flowers:** pedicels (2–)3–5(–7) mm long, not winged, mostly in pairs, connate to about (0.5–)1–1.5 mm from base, reddish-brown hairy, soon-glabrescent; perianth (8–)14–18(–20) mm long, reddish-brown hairy, soon-glabrescent, limb ellipsoid, 1–1.5 mm diameter; anthers 1.5–2 mm long; ovary narrowly ovoid, glabrous; disk-glands broadly elliptic, broadly ovate or subtruncate, sometimes with bidentate apex, free and close together or slightly connate at base, but later slightly spaced. **Fruits** broadly ellipsoid or subglobose, 2–2.5(–3.5) × 2–3 cm, glabrous, asymmetric, black when dry, shortly apiculate, slightly contracted at base; *pericarp* 2–3 mm thick, *mostly with 6 obtuse vertical ribs*; stalks 4–6(–7) mm long, 3–5(–6) mm thick, persistent.

Vernacular name. Sabah—*jaring-jaringan jawa.*

Distribution. India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. Common in Sabah (e.g., *Clemens 27083*, *SAN 52038*, *SAN 87168*, *SAN 122383*, and *SAN 129127*) and Sarawak (e.g., *Nooteboom & Chai 1850*, *S 15595*, *S 22130*, *S 35506*, and *S 44688*). Also known from Brunei (e.g., *BRUN 5226*) and Kalimantan (e.g., *Labohm 1208*)

Ecology. In primary and secondary forests, on steep slopes and hills, at altitudes to 1600 m, locally common on basalt ridges and riversides.

Uses. The wood is occasionally used for shafts of axes and sometimes for house building. Young shoots are eaten as a vegetable in Java. The fruit is reported to be poisonous.

9. **Helicia rufescens** Prain Fig. 5.

(Latin, *rufescens* = becoming reddish; referring to the indumentum of the leaves, twigs, and inflorescences)

Kew Bull. (1912) 342; Gamble *l.c.* (1914) 435; Ridley *l.c.* (1924) 142; Sleumer, Blumea 8 (1955) 25, FM 1, 5 (1955) 171; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 289; Ashton *l.c.* 334; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Lectotype** (Sleumer, 1955)**:** *Kunstler 8504*, Peninsular Malaysia, Perak, Taiping waterfall (holotype K!).

Medium-sized tree to 25 m tall, 35 cm diameter. **Bark** grey, smooth, lenticellate; inner bark yellow mottled pink, becoming brown on exposure. **Sapwood** yellowish brown. **Twigs** terete, grey to greyish brown, glabrous. **Leaves** spiral, *thinly coriaceous*, dull olive-green above and *glaucous below* when dry, shining above, glabrous; *narrowly elliptic*, (*6–*)*9–15*(*–17*) × (*2.5–*)*3–3.5*(*–4.5*) *cm*, *base long-cuneate*, *decurrent*, *margin* entire, *recurved*, *apex acuminate*; midrib raised on both surfaces; lateral veins 8–12 pairs, curving and joining near leaf margin, faint on both surfaces; intercostal venation invisible on both surfaces; *petiole 1.5–2 cm long*, 1–1.5 mm thick, swollen and smooth at base, greyish brown when dry, *glabrous.* **Inflorescences** axillary or borne on leafless older branches, solitary or in pairs, (10–)15–20 cm long, densely flowered except for 1 cm from base; *rachis* terete, 1.5–2 mm diameter, dark reddish-brown tomentose, *glabrescent*; bracts ovate, minute, *c.* 1 mm long, dark reddish-brown tomentose. **Flowers:** *pedicels* 1–2(–3) mm long, not winged, mostly in pairs and connate to about 0.5–1(–1.5) mm from base, dark reddish-brown tomentose, *glabrescent*; *perianth c.* 12 mm long, dark reddish-brown tomentose, *glabrescent*, limb clavate, *c.* 1.5 mm diameter; anthers *c.* 2 mm long; *ovary reddish-brown hairy*; disk-glands obtuse, free, spaced. **Fruits** ellipsoid, flattened laterally, 2.5–3 × (1.5–)2–2.5 cm, asymmetric, *glabrous*, *black when dry*, shortly apiculate, tip *c.* 1 mm long, at base contracted into a short stipe of *c.* 1 mm long; *pericarp c. 1 mm thick.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, rare (e.g., *S 27236*). Also known from Brunei (e.g., *S 4867*).

Ecology. From sea level to 1500 m altitude (Peninsular Malaysia). In Sarawak and Brunei, the species is confined to lowland mixed dipterocarp forest on yellow sandy soils and *kerangas* forest respectively.

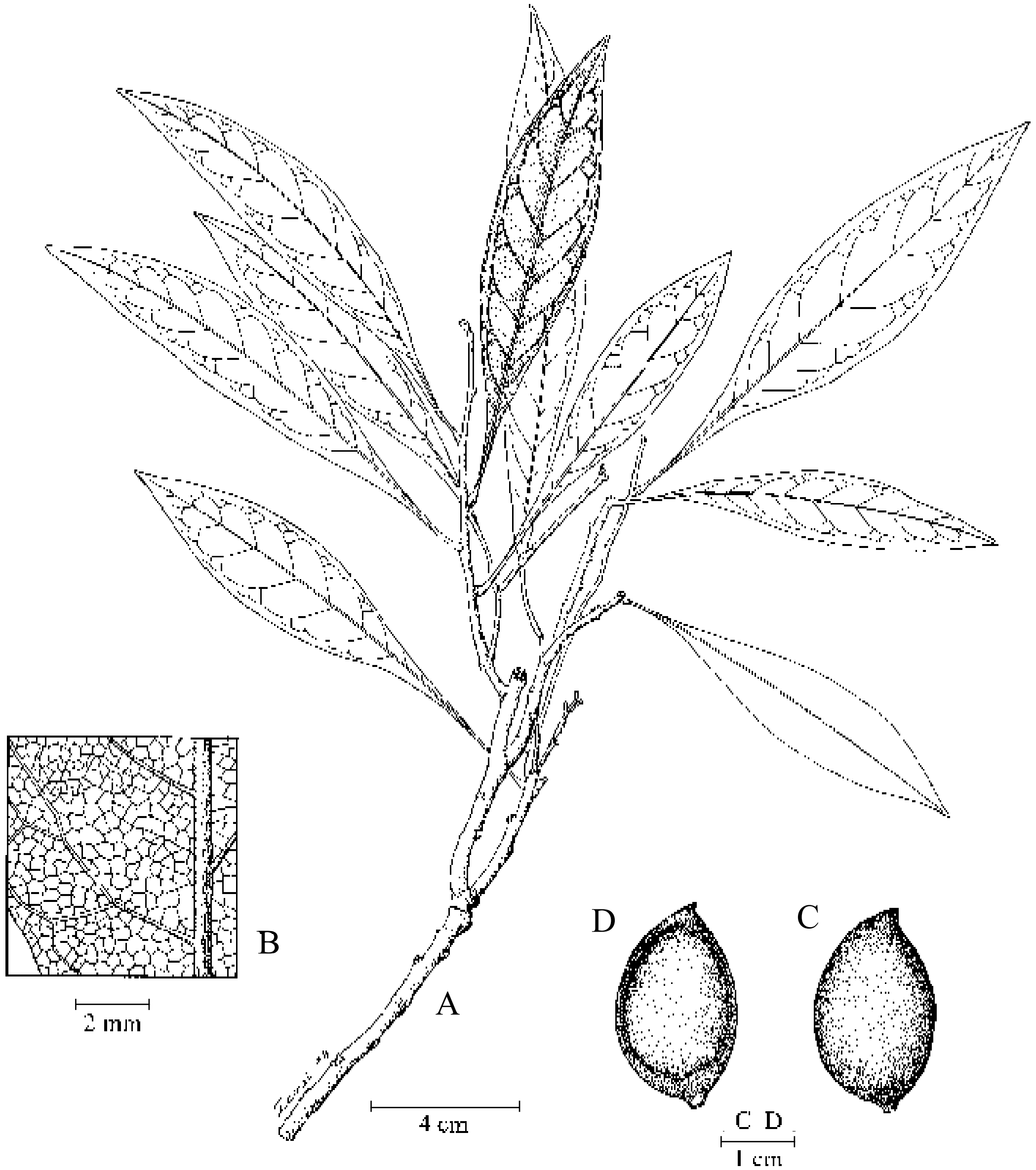

Fig. 5. *Helicia rufescens.* A, leafy twig; B, detail of lower leaf surface; C, fruit; D, longitudinal section of fruit. (All from *S 27236.*)

10. **Helicia serrata** (R.Br.) Blume

(Latin, *serratus* = toothed; the leaf margin)

Ann. Sci. Nat. 2, 1 (1834) 215; Sleumer, Blumea 8 (1955) 34, FM 1, 5 (1955) 176; Backer & Bakhuizen *f. l.c.* 275; Kochummen, TFM 2 (1973) 316; Anderson *l.c.* 289; Ashton *l.c.* 335; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Basionym:** *Roupala serrata* R.Br., Trans. Linn. Soc. 10 (1810) 192. **Type:** *Chr. Smith s.n.*, Moluccas, Ambon, Nusalaut (holotype BM!). **Synonyms:** *Helicia curtisii* Gamble, Kew Bull. (1913) 116, Ridley *l.c.* (1924) 142; *H. scortechinii* Gamble *l.c.* (1913) 117, Ridley *l.c.* (1924) 143; *H. brachyantha* Merr., Pap. Mich. Acad. Sci. 24 (1939) 66.

Distribution. A species consisting of two varieties distributed in Sumatra, Peninsular Malaysia, Java, Borneo, and Maluku. In Sabah and Sarawak, only var. *serrata* is known. Another one, var. *oreophila* Sleumer, occurs in Sumatra and Java.

var. **serrata**

Small to medium-sized tree, 20(–25) m tall, 25(–60) cm diameter. **Bark** grey to dark brown, smooth; inner bark pale brown, invaginating into sapwood. **Sapwood** pale yellow. **Twigs:** young parts subangular, older parts terete, greyish or yellowish brown, tips densely reddish-brown hairy when young, soon-glabrescent, older ones glabrous. **Leaves** spiral, *thinly coriaceous*, olivaceous and not shining above, *dull brownish below*, appressed hairy on both surfaces, becoming glabrous above and glabrescent below; *elliptic* or *elliptic-oblong*, sometimes *oblanceolate* or *obovate*, (*8–*)*10–20*(*–24*) × (*3.5–*)*4–8*(*–10*) *cm*, *base attenuate and decurrent*, *margin serrate* at least apically or *sometimes entire*, *not recurved*, *apex short-acuminate* to *acute*; midrib slightly raised above, prominent below; lateral veins 8–10 pairs, curved and more or less joined near leaf margin, faintly visible above, prominent below; intercostal venation invisible above, slightly raised below; *petiole* (*0.2–*)*0.3–0.6*(*–1*) *cm long*, 1–2 mm thick, swollen and wrinkled at base, deep brown when dry, *glabrous*. **Inflorescences** *axillary in axils of lower leaves* or *borne on leafless older branches*, solitary or paired, (5.5–)9–12(–15) cm long, densely flowered except for 0.5–1(–1.5) cm from base; *rachis* terete, *c.* 1 mm diameter, initially densely reddish-brown tomentose, *glabrescent*; bracts ovate-acuminate, minute, *c.* 1.5(–2) mm long, reddish-brown tomentose. **Flowers:** pedicels (1.5–)2–3(–4) mm long, not winged, mostly in pairs, connate to 1–2 mm from base, reddish-brown tomentose; *perianth* (4–)5–8(–10) mm long, initially reddish-brown tomentose, *glabrescent*, limb ellipsoid, 0.8–1(–1.5) mm diameter; anthers 1.5–2 mm long; *ovary* narrowly ovoid, *densely reddish-brown hairy*; disk-glands oblong or ovate-oblong, free, slightly spaced. **Fruits** depressed ovoid, 1.5–1.9(–2.2) × (1.3–) 1.5–2.2(–2.5) cm, slightly asymmetric, *glabrous*, *dark brown* or *black when dry*, rarely shortly apiculate, tip *c.* 0.5 mm long, without stipe; *pericarp* smooth, *0.5–1 mm thick*, with a distinct prominent rib; stalks 3–4 mm long, 2–3.5 mm thick, persistent.

Vernacular names. Sarawak—*breyanlana* (Iban); *gagelap* (Bisayah).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, and Maluku. In Sabah, found in Kinabatangan, Beluran (e.g., Bongaya FR), and Lamag districts (e.g., *SAN A 4651*, *SAN 36404*, *SAN 70906*, *SAN 81852*, and *SAN 95287*). In Sarawak, known from Bintulu and Limbang districts (e.g., *Ding Hou 430*, *S 15571*, *S 22550*, *S 26033*, and *S 59359*). In Brunei, recorded from Belait, Tutong and Brunei-Muara districts (e.g., *BRUN 15339*, *Coode MC 7720*, *Kirkup DK 697*, *Sands MS 5969*, and *Wong WKM 1632*).

Ecology. Lowland mixed dipterocarp to lower montane forests, at altitudes to 1600 m; locally common on river banks on clay-rich alluvium soils, and on basalt and shale ridges.

11. **Helicia sessilifolia** R.C.K.Chung Fig. 6.

(Latin, *sessilis-* = stalkless, *folius* = -leafed; with sessile leaves)

Gard. Bull. Sing. 50 (1998) 151. **Type:** *Lee S 52436*, Borneo, Sarawak, Limbang Division, Lawas, Ulu Trusan, Bt. Tebunan (holotype KEP!; isotypes K, L, MO, SAN!, SAR!).

Treelet to small tree to 10 m tall. **Twigs** *slender*, *young parts subangular*, older ones terete, light brown, glabrous. **Leaves** spiral or subopposite, *thinly coriaceous*, yellowish brown when dry, *not shining above*, glabrous; *broadly oblong* to *elliptic*, *rarely obovate*, (6–) 9–17 × (4.5–)5–8.5 cm, *base rounded* to *subcordate*, *margin entire*, apex acute; midrib slightly raised above, prominent below; lateral veins 6–7 pairs, curving and joining near leaf margin, prominent on both surfaces; intercostal venation inconspicuous on both surfaces; petiole very short, slightly swollen at base, dull brown, glabrous. **Inflorescences** axillary, solitary, *c.* 7 cm long, laxly flowered near base; *rachis* terete, *c.* 1 mm diameter, *glabrous*; bracts minute, less than 0.5 mm long, glabrous. **Flowers:** *pedicels* 5–6 mm long, not winged, *smooth*, paired, connate to *c.* 2–3 mm from base, *glabrous*; *perianth* (12–)16–19 mm long, *glabrous*, *limb* ellipsoid, *0.8–1.2 mm diameter*; *anthers 1–1.5 mm long*; ovary ovoid, glabrous; *disk-glands* nearly entirely *connate into a crenulate ring*. **Fruits** *ellipsoid*, *4–4.5 × 2.4–2.7 cm*, slightly asymmetric, glabrous, *chesnut-brown when dry*, *shortly apiculate*, *tip 1–4 mm long*, *at base contracted into a short stipe of c. 3 mm long*; *pericarp smooth*, *2.5–3 mm thick*.

Distribution. Endemic to Borneo, and restricted to Sarawak and Sabah. In Sarawak, known from Bt. Tebunan, Lawas (*S 52434* and *S 52436*), and in Sabah recorded from Tambunan (*SAN 60837* and *SAN 111305*).

Ecology. Mixed dipterocarp forest, at altitudes to 900 m.

12. **Helicia symplocoides** R.C.K.Chung

(Greek, *-oides* = resembling; with leaves resembling those of *Symplocos*, Symplocaceae)

Gard. Bull. Sing. 50 (1998) 154. **Type:** *Chew & Corner RSNB 4786*, Borneo, Sabah, Mt. Kinabalu, Mesilau Cave (holotype SAN!; isotypes K, L).

Tree *c.* 15 m tall, 25 cm diameter. **Twigs** terete, grey or greyish brown, glabrous with distinct leaf scars to 3 mm diameter. **Leaves** spiral, *thickly coriaceous*, deep green and not shining above, brown below, glabrous; obovate, *5–10 × 2.5–5 cm*, *base cuneate*, *decurrent*, margin entire or occasionally with 1–3 minute teeth in the upper half, recurved, *apex obtuse* or *emarginate*; midrib raised above, prominent below; lateral veins 6–8 pairs, curving near leaf margin and joining with next one to form looped intramarginal veins, visible below, inconspicuous above; intercostal venation inconspicuous on both surfaces; *petiole 0.2–0.4 cm long*, 1.5–2 mm thick, swollen and wrinkled at base, dark brown when dry, glabrous. **Flowers** unknown. **Fruits** ellipsoid to broadly ellipsoid, 1.5–1.7 × 1.2–1.4 cm, asymmetric, glabrous, black when dry, shortly apiculate, tip *c.*

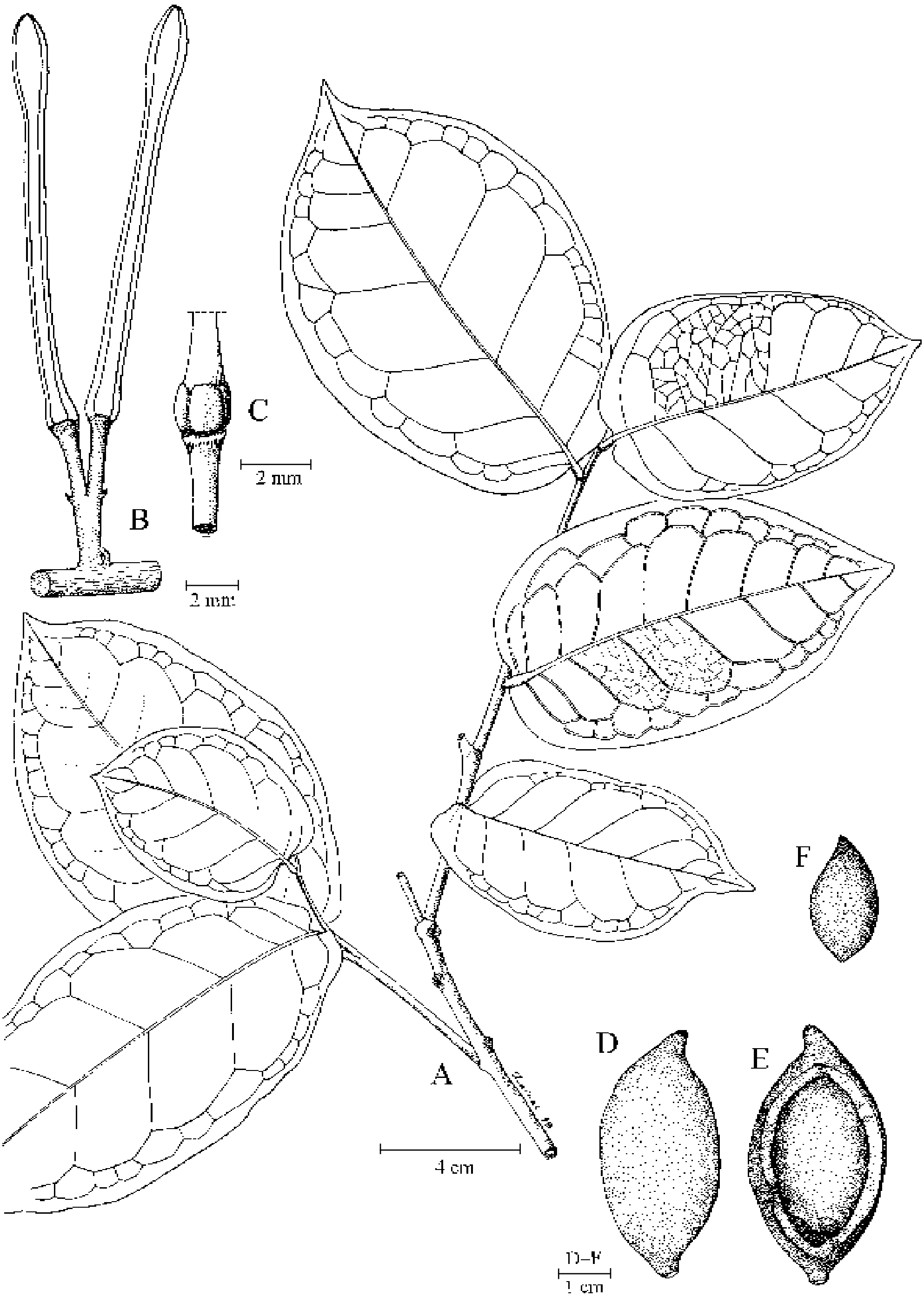

Fig. 6. *Helicia sessilifolia*. A, leafy twig; B, flower buds; C, base of ovary with disk-glands; D, fruit; E, longitudinal section of fruit; F, seed. (A–C from *S 52436*, D–F from *S 52434*.)

1 mm long, at base contracted into a short stipe of *c.* 2 mm long; pericarp smooth, 0.8–1.5 mm thick; stalks 5–7 mm long, 1.5–2 mm thick, persistent.

Distribution. Endemic to Borneo (Sabah). So far known from a single collection, *Chew & Corner RSNB 4786*, from Mt. Kinabalu, Mesilau Cave, on ultramafic soils.

Ecology. Lower montane forest at *c.* 1850 m altitude.

13. **Helicia sp. A**

Chung *l.c.* (2001) 543. **Synonym:** *Helicia robusta* var. *integrifolia auct. non* (Elmer) Sleumer: Sleumer, Blumea 8, 1 (1955) 57, FM 1, 5 (1955) 186, *p.p.*, *quoad specim. Clemens 55095*.

Treelet. **Leaves** *subopposite or verticillate*, *thinly coriaceous*, glabrous; oblanceolate, (*8*–) *11–16.5* × (*2.5*–)*3.5–5 cm*, *base cuneate*, *decurrent*, *margin* entire, *recurved*, *apex acute*; midrib raised on both surfaces; lateral veins 8–10 pairs, curving and joining near leaf margin, prominent on both surfaces; intercostal venation raised on both surfces; *petiole 0.8–1 cm long*, *2–3 mm thick*, swollen at base, glabrous. **Inflorescences** axilary or borne on leafless older branches, solitary, 28–32 cm long, laxly flowered except for 2.5 cm from base; rachis terete, *c.* 3 mm diameter. **Flowers**: *pedicels* 9–10 mm long, *not winged*, mostly in pairs, connate at base; perianth 20–25 mm long; *ovary glabrous*; *disk-glands connate into a crenulate ring*. **Fruits** unknown.

Distribution. Known only from Marai Parai, Mt. Kinabalu, Sabah (*Clemens 55095*), on ultramafic soils.

Ecology. Montane forest at *c.* 3400 m altitude.

2. **HELICIOPSIS** Sleumer

(resembling the genus *Helicia*)

palis (Iban), *pasis* (Bidayuh)

Blumea 8 (1955) 79, FM 1, 5 (1955) 190; Backer & Bakhuizen *f.*, FJ 1 (1964) 275; Kochummen, TFM 2 (1973) 317; Anderson, CLTS (1980) 289; Cockburn, TS 2 (1980) 78; Ashton, MNDTS 2 (1988) 336; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 292; Coode *et al.* (eds.), CLBD (1996) 259; PROSEA 5, 3 (1998) 286; Chung, J. Trop. For. Sci. 13 (2001) 536.

Small to medium-sized trees. **Leaves** spiral, *generally of 2 forms*, *unlobed or deeply lobed*, entire, sessile or petioled, intercostal venation reticulate. **Inflorescences** racemose, many-flowered, axillary or borne on leafless older branches; bracts subulate, small, or linear-elongate, caducous or persistent; bracteoles minute, caducous; pedicel mostly in pairs, free or connate to four fifths of their length. **Flowers** *unisexual* (*plants dioecious*); perianth tube straight, slender, limb clavate or ellipsoid, attenuate towards base in male flowers, dilated at base by the swollen ovary in female flowers, segmens 4, curled and twisted at anthesis; stamens 4, sessile or nearly so, inserted at base of perianth limb; anthers oblong, connective apiculate; ovary sessile, style slender, glabrous, clavate towards apex; *stigma* in female flowers *discoid*, *lateral*, *stigmatic surface* glandular, *with distinct cleft*, *absent in male flowers*; *ovules* 2, *orthotropous*, hanging from top of the cavity; disk-glands 4, free, mostly forming a cup. **Fruit** a drupe, cylindric-ellipsoid; *pericarp differentialed into 3 distinct layers*, exocarp smooth, leathery, thin, *mesocarp with numerous radial fibrous tissue*, persistent, sometimes early dissolved or nearly absent, endocarp hard, woody at least in inner part, mostly thick, outer face reticulate-lacunose, lacunae sometimes perforated. **Seed** 1, nearly globose, or seeds 2, hemispherical, wrinkled in the upper part; testa thin; cotyledons large, fleshy.

Distribution. About 13 species, distributed in Burma, Indo-China, SE China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines (Palawan, Mindanao). Seven species are known in Sabah and Sarawak, of which two are endemic.

Ecology. In primary lowland to lower montane forest, at altitudes to 1600 m. Often associated with small streams. *H. montana* is confined to montane forest.

Uses. The wood of *Heliciopsis* has a nice oak-like streaks, and is used for making high class furniture, superior joinery, interior finish and veneer (PROSEA *l.c.* 286).

Taxonomy. The genus shares a few similar morphological characters with *Helicia* Lour. (sessile anthers) and *Macadamia* F.v.M. (orthotropous ovules, pendent from the top of the cavity), but is very different from both by the unisexual flowers, the peculiar structure of the pericarp, and the pollen which has a reticulate sexine. Sleumer (1955) observed that the stigma of *Heliciopsis* is punctiform and terminal. However, Chung (2001) showed that the stigma is discoid, lateral, and the stigmatic surface is provided with distinct cleft. Such a stigma was, however, not observed in the functionally male flowers, a character found consistently in all species of *Heliciopsis.* The characters of the stigma just described can be used to distinguish species of *Heliciopsis* from those of *Helicia* which have a punctiform, terminal stigma without a cleft.

Key to *Heliciopsis* species

1. Petioles of unlobed leaves shorter than 3 cm……………………………………..........2
Petioles of unlobed leaves longer than 4 cm…………………………………...............4

2. Base of unlobed leaves attenuate and decurrent; lateral veins 5–6 pairs.. **H. litseifolia**
Base of unlobed leaves cuneate, non-decurrent; lateral veins 12–18 pairs.......………..3

3. Unlobed leaves obovate or broadly obovate-oblong, initially covered with crisp reddish-brown hairs on both surfaces, glabrescent, apex broadly rounded, dark brown when dry. Fruits broadly ellipsoid, black when dry; exocarp 0.5–1 mm thick, mesocarp made up of *c.* 1 mm long fibres, endocarp *c.* 1 mm thick……………..….**6. H. rufidula**
Unlobed leaves lanceolate or oblanceolate-oblong, glabrous on both surfaces, apex short-acuminate or subacute, olivaceous, greenish or yellowish brown when dry. Fruits

cylindric-ellipsoid, brown when dry; exocarp 1–1.5 mm thick, mesocarp made up of 2–3 mm long fibres, endocarp 1–2 mm thick............................**7. H. velutina**

4. Petiole of unlobed leaves 8–14 cm long; base of unlobed leaves attenuate and decurrent...**1. H. artocarpoides**
   Petiole of unlobed leaves 3.5–7 cm long; base of unlobed leaves cuneate and non-decurrent...5

5. Unlobed leaves oblong-lanceolate, margin plane, apex obtuse; lateral veins 26–30 pairs...**3. H. mahmudii**
   Unlobed leaves elliptic, broadly elliptic to narrowly oblong, margin recurved, apex rounded; lateral veins 6–14 pairs..6

6. Petiole of unlobed leaves glabrous, 4.5–6 cm long; lateral veins 6–14 pairs. Pedicels of male flowers 4–5 mm long; perianth of male flowers 4–5 mm long..**4. H. montana**
   Petiole of unlobed leaves initially reddish-brown hairy, glabrescent, 3.5–4.5 cm long; lateral veins 7–8 pairs. Pedicels of male flowers 8–10 mm long; perianth of male flowers 12–15 mm long..**5. H. percoriacea**

1. **Heliciopsis artocarpoides** (Elmer) Sleumer Fig. 7.

(Greek, *-oides* = resembling; with leaves resembling those of *Artocarpus*, Moraceae)

Blumea 8 (1955) 83, FM 1, 5 (1955) 192; Anderson *l.c.* 289; Cockburn *l.c.* 78; Ashton *l.c.* 336; Whitmore, Tantra & Sutisna *l.c.* 292; Coode *et al.* (eds.) *l.c.* 259; PROSEA *l.c.* 287. **Basionym:** *Helicia artocarpoides* Elmer, Leafl. Philip. Bot. 5 (1913) 1826, Merrill, PEB (1929) 52, Masamune, EPB (1942) 257. **Type:** *Elmer 12946*, the Philippines, Palawan, Puerto Princessa, Mt. Pulgar (holotype PNH†; isotypes A, B, BM!, BO, E, K!, L, M, NY).

Tree to 25 m tall, 25 cm diameter. **Bark** dark, smooth with knobby scars; inner bark brittle, yellow, brown, or whitish. **Sapwood** yellow or white with prominent rays. **Twigs** terete, greyish brown to dark brown, reddish-brown hairy when young, soon-glabrescent. **Unlobed leaves** thinly coriaceous, dark brown when dry, slightly shining above, glabrous; obovate-oblong, 30–40 × 9–12.5 cm, *base attenuate* and *decurrent*, margin entire, apex rounded; midrib raised above, prominent below; lateral veins 14–16 pairs, slightly curved upwards, slightly raised above, distinctly prominent below; intercostal venation slightly raised on both surfaces; *petiole* (*0.5–*)*0.8–1.4 mm long*, 1–3 mm thick, swollen at base, dark brown when dry, glabrous. **Deeply lobed leaves** glabrous, 35–90 × 25–55 cm; lobes in 2–8 pairs, narrowly oblong or lanceolate, apex shortly acuminate, sinuses rounded and mostly 1–3 cm distant from common midrib; lateral veins 10–15 pairs, most straight, curving into a distinct intramarginal vein; intercostal venation visible on both surfaces; petiole (6–)10–18 cm long, 3–5 mm thick, swollen and wrinkled at base, initially reddish-brown hairy, glabrescent or glabrous. **Inflorescences** borne on stems or leafless older branches, solitary or in clusters of 2–3 (rarely up to 10), 12–30 cm long, densely flowered except for 2–3 cm from base; rachis 1.5–2.5(–3) mm diameter, densely reddish-brown hairy with appressed hairs; bracts subulate, 0.5–1 mm long, caducous. **Flowers:** pedicels (3–)5–7(–8) mm long, mostly in pairs, free or connate to 2–5 mm from base, reddish-brown hairy; perianth 14–15 mm long, reddish-brown hairy, limb clavate, 1.5–2.3 mm diameter; male flower with anthers 2–2.5 mm long; female flower with ovary narrowly ovoid, glabrous; disk-glands ovate-

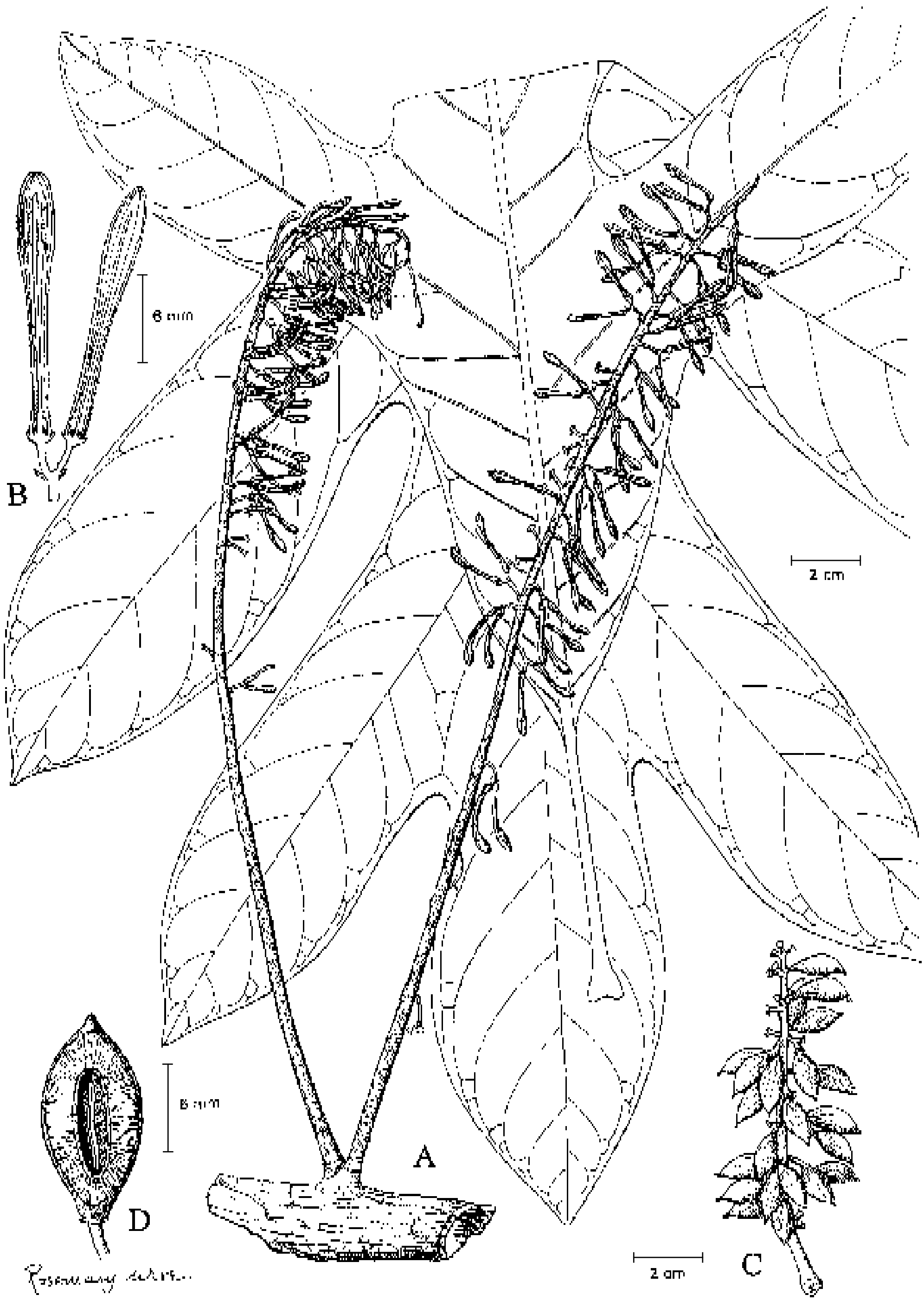

Fig. 7. *Heliciopsis artocarpoides.* A, flowering (male) leafy twig; B, longitudinal section of male flower buds; C, fruits; D, longitudinal section of fruit. (A–B from *S 40002*, C–D from *KEP 80440.*)

oblong, free, closed together. **Fruits** cylindric-ellipsoid, 3.2–4(–4.5) × (2–)2.5–3 cm, smooth, shining and dark-coloured when dry; exocarp leathery, thin; mesocarp built up by radial, soft brown fibres *c.* 3 mm long; endocarp hard, woody, reticulate-lacunose, *c.* 1 mm thick; stalks *c.* 10 mm long, *c.* 3 mm thick, persistent.

Vernacular names. Sabah—*kerungguon* (Dusun Kinabalu), *kurunggu*, *putat* (Malay). Sarawak—*dagu* (Bidayuh).

Distribution. Borneo and the Philippines. In Sabah, known from Mt. Kinabalu, Kinabatangan, Sandakan, and Tawau (e.g., *KEP 80440*, *SAN 21791*, *SAN 35570*, *SAN 87241*, and *SAN 108210*). In Sarawak, scattered (e.g., *S 25403*, *S 28703*, *S 40002*, *S 45251*, and *S 52500*). Also occurs in Brunei (*Coode MC 6973* and *Sands MS 5704*) and Kalimantan (*Argent & Amiril 9368*).

Ecology. Moderately common in mixed dipterocarp forest at altitudes to 1600 m; also in *kerangas* forest.

Uses. Paste of burnt leaves is used as a poultice for rheumatism (Bidayuh, Sarawak).

2. **Heliciopsis litseifolia** R.C.K.Chung Fig. 8.

(with leaves resembling those of *Litsea*, Lauraceae)

Gard. Bull. Sing. 50 (1998) 154. **Type:** *Jacobs 5401*, Borneo, Sarawak, Kapit, Belaga (holotype SAR!; isotypes B, CANB, G, K, L, S, US).

Small to medium-sized tree, 6–25 m tall, 10–25(–50) cm diameter. **Bark** mottled greyish green and brown, smooth, hoop-marked; inner bark yellowish brown, brittle. **Sapwood** white. **Twigs:** youngest parts angular, older ones terete, grey-brown, glabrous. **Unlobed leaves** thinly coriaceous, yellowish green, olivaceous brown, not shining above, glabrous; elliptic to broadly elliptic, 10–25 × 4–11.5 cm, *base attenuate*, *decurrent*, margin entire, apex acute or acuminate; midrib slightly raised above, prominent below; *lateral veins 5–6 pairs*, curved upwards and joining near leaf margin to form intramarginal vein-loops, prominent on both surfaces; intercostal venation reticulate, faint above, visible below; *petiole* (*0.5–*)*1–2.5 cm long*, 2–2.5 mm thick, swollen at base, black and rarely yellowish brown when dry, glabrous. **Deeply lobed leaves** unknown. **Inflorescences** axillary or borne on leafless older branches, solitary, 12–26 cm long, laxly flowered except for *c.* 3 cm from base; rachis 1–1.5(–2) mm diameter, reddish-brown hairy, soon-glabrescent; bracts subulate, 1–2 mm long, caducous, reddish-brown hairy. **Flowers:** pedicels 5–8 mm long, mostly in pairs, connate up to 3–5 mm from base, reddish-brown hairy; perianth 8–10 mm long, reddish-brown hairy to glabrescent, limb clavate, *c.* 1.5 mm diameter; male flower with anthers 1–1.5 mm long; female flower with ovary ovoid, glabrous; disk-glands truncate, free, spaced. **Fruits** cyclindric-ellipsoid, (2.7–)3–3.5(–4.5) × (1.7–)2–2.2(–3.5) cm, smooth, shining black when dry; exocarp leathery, *c.* 1 mm thick; mesocarp made up of radial, soft brown fibres of *c.* 2.5 mm long; endocarp woody, up to 3 mm thick; stalks 10–12 mm long, 3–4 mm thick, persistent.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, scattered and known by several collections from Sabah (e.g., *SAN 35872*, *SAN 67659* and *SAN 110338*), Sarawak (e.g.,

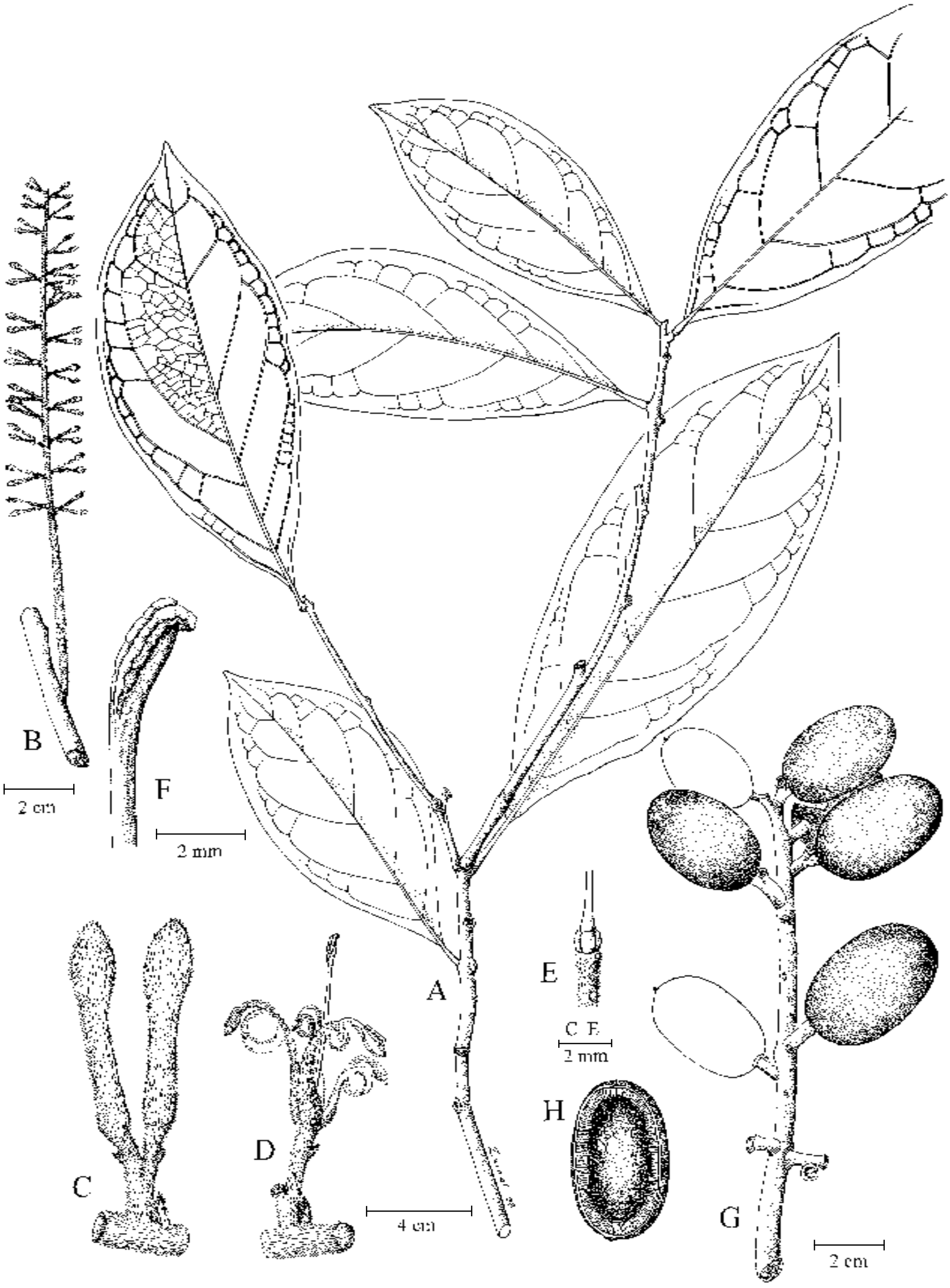

Fig. 8. *Heliciopsis litseifolia.* A, leafy twig; B, male inflorescence; C, male flower buds; D, open female flower; E, base of ovary with disk-glands; F, stigma; G, infructescence; H, longitudinal section of fruit. (A and G–H from *SAN 67659*, B–C from *S 34497*, D–F from *Jacobs 5401*.)

Jacobs 5401, *S 19547*, *S 29994*, *S 34320*, and *S 48191*) and Kalimantan (e.g., *Ridsdale PBU 595* and *Church 173*).

Ecology. Lowland and hill dipterocarp forest, at altitudes to 900 m.

3. **Heliciopsis mahmudii** (P.Chai) R.C.K.Chung Fig. 9.

(named in honour of Haji Abdul Taib Mahmud, the Honourable Chief Minister of Sarawak)

J. Trop. For. Sci. 13 (2001) 540. **Basionym:** *Helicia mahmudii* P.Chai, Sandakania 7 (1996) 59. **Type:** *Chai S 33791*, Borneo, Sarawak, Lanjak-Entimau Wildlife Sanctuary (holotype SAR!; isotypes K, KEP!, L, MO, SAN).

Small tree *c.* 5 m tall, 4 cm diameter. **Bark** surface dark brown, thin, finely vertically cracked. **Twigs** terete, dark brown, youngest part reddish-brown hairy, late-glabrescent. **Unlobed leaves** thinly to thickly coriaceous, dull olive-green above, light creamy brown below when dry, slightly bullate and shining above, glabrous; *oblong-lanceolate*, 29–42 × 9–11.5 cm, *base cuneate*, *non-decurrent*, *margin entire*, *plane*, *apex obtuse* and shortly pointed; midrib distinctly raised and with sharp angle on both surfaces; *lateral veins* ascending, *26–30 pairs*, visible above, raised below; intercostal venation visible on both surfaces; *petiole 4.5–6(–7) cm long*, 7–13 mm thick, swollen and wrinkled at base, deep brown when dry, glabrous. **Deeply lobed leaves** unknown. **Female inflorescences** borne on stem *c.* 30 cm above ground, solitary, *c.* 5 cm long, laxly flowered except for *c.* 1 cm from base; rachis terete, *c.* 1.5 mm diameter, reddish-brown hairy; bracts subulate, to *c.* 2 mm long, reddish-brown hairy, caducous. **Female flowers:** pedicels (4–)5–6 mm long, solitary or mostly in pairs, connate to 0.8–1.5 mm from base, reddish-brown hairy; perianth 7–8 mm long, reddish-brown hairy; limb ellipsoid, *c.* 1(–1.5) mm diameter; anthers 1.5–2 mm long, sterile; ovary ovoid, glabrous; disk-glands truncate, free, 0.2–0.4 mm apart from each others. **Male inflorescences, male flowers** and **fruits** unknown.

Distribution. Endemic to Borneo. Rare and known from Lanjak-Entimau Wildlife Sanctuary (*S 33791*) and Bintulu (*S 66455*), Sarawak.

Ecology. In open places colonised by secondary pioneer vegetation following landslips, at 600–850 m altitude.

4. **Heliciopsis montana** Symington *ex* Kochummen

(Latin, *montanus* = growing in the mountains)

Gard. Bull. Sing. 26 (1973) 287, TFM 2 (1973) 317; Turner, Gard. Bull. Sing. 47 (1995) 409; Chung *l.c.* (2001) 543. **Type:** *Kochummen FRI 16172*, Peninsular Malaysia, Pahang, Fraser's Hill (holotype KEP!).

Medium-sized tree to 26 m tall, 60 cm diameter. **Sapwood** white. **Twigs** terete, grey-brown, young parts hairy, later glabrous. **Unlobed leaves** thickly coriaceous, yellowish green when dry, slightly shining above, glabrous; *elliptic* to *narrowly oblong*, (9–)15–21(–39.5) × (3.5–)6–9.8(–19.5) cm, *base cuneate*, *not decurrent*, occasionally slightly asymmetric, *margin entire*, *recurved*, *apex rounded*; midrib slightly raised on both surfaces; *lateral veins 6–10(–14) pairs*, arching and

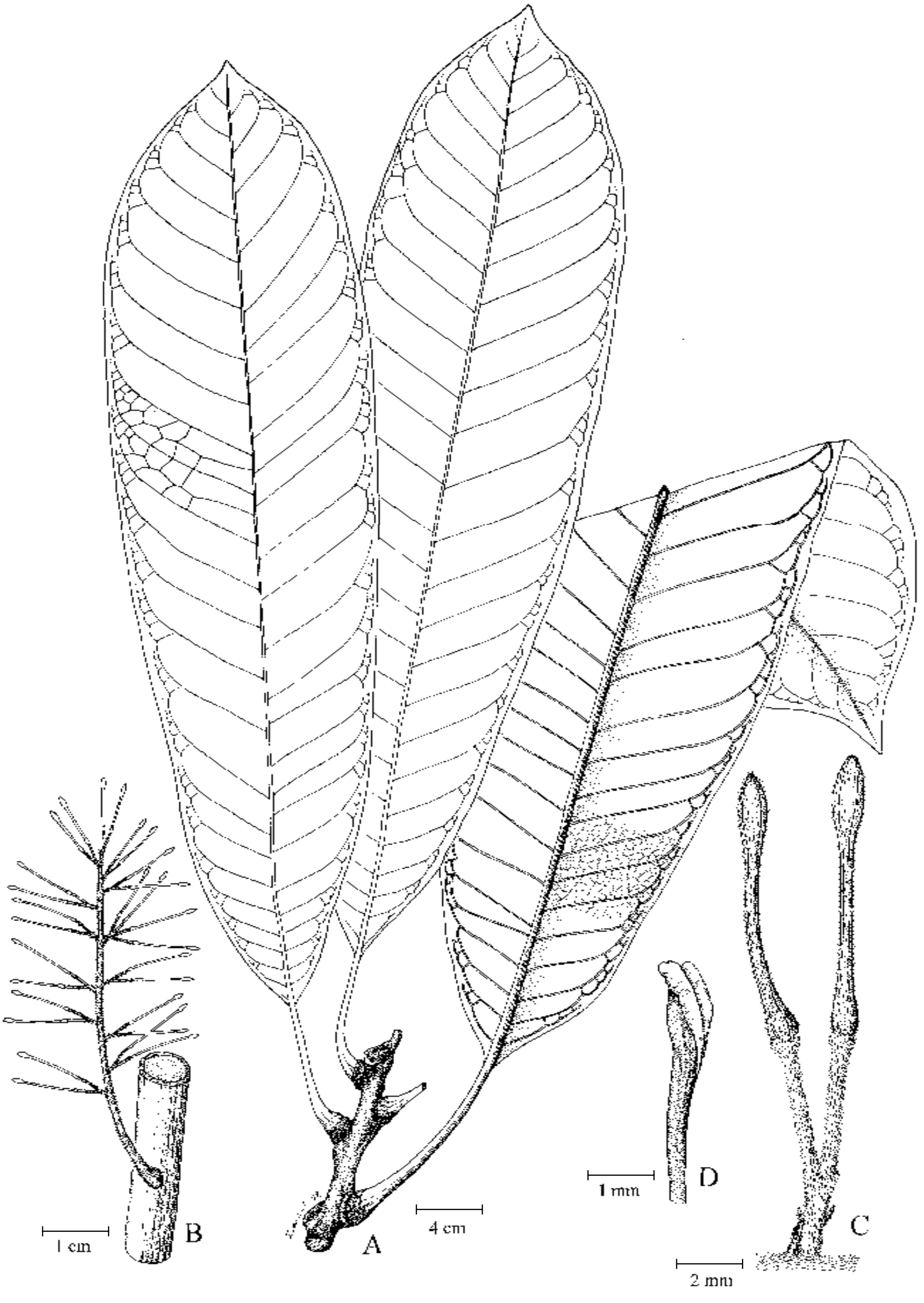

Fig. 9. *Heliciopsis mahmudii.* A, leafy twig; B, female inflorescence; C, female flower buds; D, stigma. (All from *S 33791.*)

joining near leaf margin to form intramarginal veins, slightly raised on both surfaces; intercostal venation faintly visible on both surfaces; *petiole 4.5–6 cm long*, 1.5–3 mm thick, slightly swollen at base, dark brown, *glabrous*. **Deeply lobed leaves** glabrous, 48–53.5 × 24–27 cm; lobes in 3–5 pairs, oblong, apex acute, sinuses rounded and 1.5–2 cm distant from common midrib; lateral veins 9–11 pairs, looping and joining at leaf margin to form a distinct intramarginal vein; intercostal venation distinct below, visible above; petiole to 10 cm long, to 5 mm thick, dark brown, glabrous. **Male inflorescences** axillary, solitary, *c.* 14 cm long, laxly flowered except for *c.* 3 cm from base; rachis *c.* 2 mm diameter, densely reddish-brown hairy; bracts subulate, 1–2 mm long, caducous, reddish-brown hairy. **Male flowers:** *pedicels 4–5 mm long*, mostly in pairs, connate to 3–4 mm from base, reddish-brown hairy; *perianth 4–5 mm long*, reddish-brown hairy, limb clavate, 1–1.5 mm diameter; anthers *c.* 1 mm long. **Female inflorescences** and **female flowers** unknown. **Fruits** oblong, 2.8–3.8 × 2.5–3 cm, smooth, shining black when dry; exocarp leathery, *c.* 2 mm thick; mesocarp made up of radial, soft brown fibres of *c.* 3 mm long; endocarp hard, woody, thin; stalks *c.* 6 mm long, *c.* 3 mm thick, persistent.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon and known by a single collection (*SAN 76428*) from Pinosuk Plateau, Mt. Kinabalu, Ranau, Sabah.

Ecology. Lower montane forest, at 1500–1800 m altitude.

5. **Heliciopsis percoriacea** R.C.K.Chung Fig. 10.

(Latin, *per-* = very; *coriaceus* = leathery; referring to the leaves)

Gard. Bull. Sing. 50 (1998) 158. **Type:** *Othman et al. S 49967*, Borneo, Sarawak, Lundu, G. Pueh (holotype KEP (Sheet 1)!; isotypes K, KEP (Sheet 2)!, L, MO, SAN!, SAR!).

Medium-sized tree to 21 m tall, 36 cm diameter. **Bark** greyish brown, smooth. **Twigs** terete, greyish brown, reddish-brown hairy when young, soon becoming glabrous. **Unlobed leaves** *thickly coriaceous*, olivaceous or yellowish brown when dry, shining above, glabrous; *broadly elliptic*, (10–)12–18(–21) × (7–)8–11(–12.5) cm, *base acute*, *margin entire*, *recurved*, *apex rounded*; midrib slightly raised above, prominent below, reddish-brown hairy, soon-glabrescent; *lateral veins 7–8 pairs*, curving and joining near leaf margin, slightly raised above, prominent below; intercostal venation prominent on both surfaces; *petiole 3.5–4.5 cm long*, 2.5–3 mm thick, *reddish-brown hairy when young*, *glabrescent*. **Deeply lobed leaves** unknown. **Inflorescences** borne on leafless older branches, solitary, 26–28 cm long, laxly flowered except for 1–2 cm from base; rachis terete, *c.* 2.5 mm diameter, reddish-brown hairy; *bracts subulate*, *c. 1 mm long*, caducous, reddish-brown hairy. **Flowers:** *pedicels 8–10 mm long*, in pairs, connate to 4–6 mm from base, reddish-brown hairy; *perianth 12–15 mm long*, reddish-brown hairy, limb ellipsoid, *c.* 2.5 mm diameter; male flower with anthers *c.* 2 mm long; female flower with ovary ovoid, glabrous; disk-glands ovoid, free, slightly distant from each other. **Fruits** unknown.

Distribution. Endemic to Borneo. Rare, known from G. Pueh, Sarawak (*S 49967*) and Mt. Tambuyukon, Sabah (*Nais et al. SNP 4891*).

Ecology. In *kerangas* forest and forest on ultramafic soils.

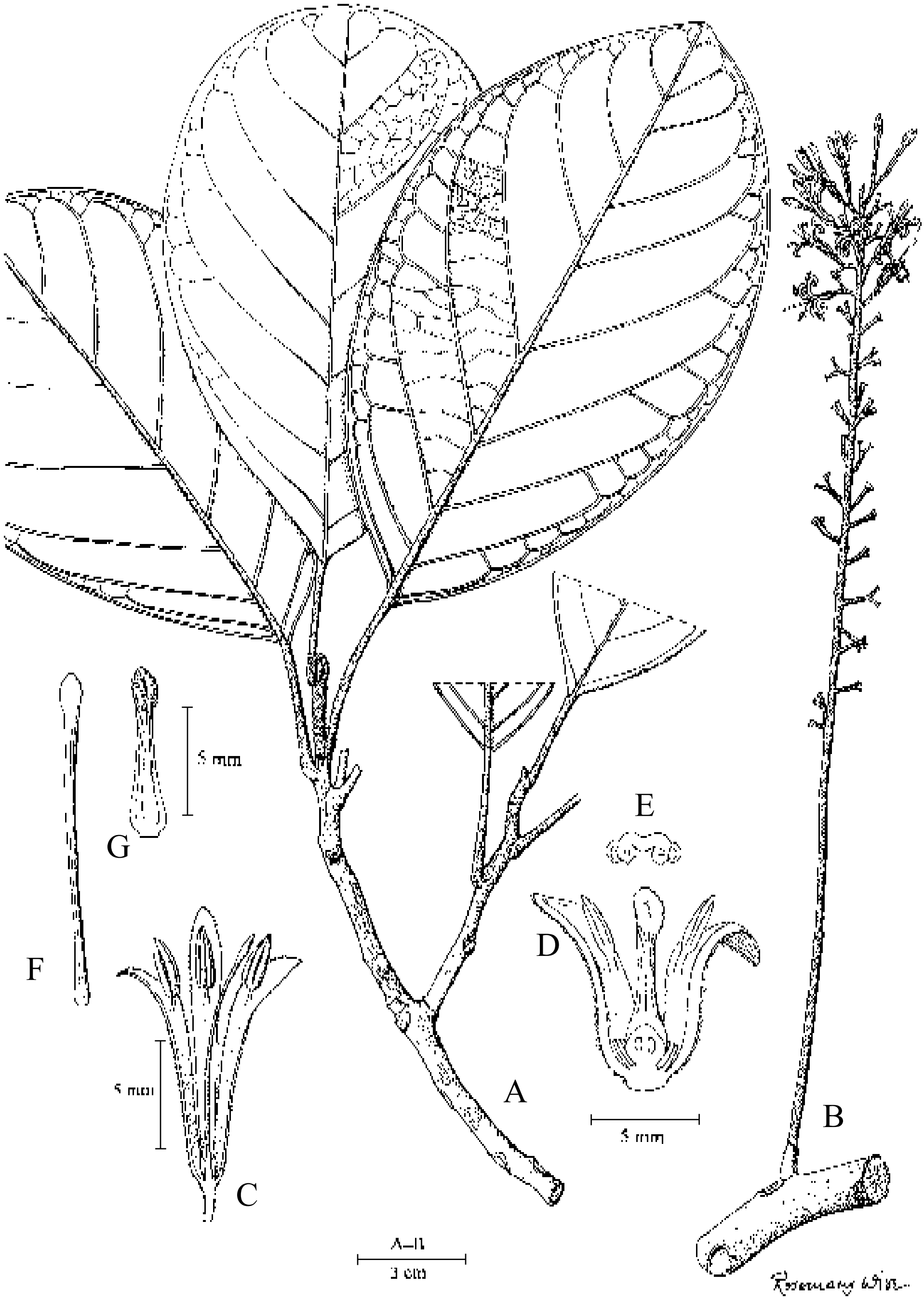

Fig. 10. *Heliciopsis percoriacea*. A, leafy twig; B, male inflorescence; C, longitudinal section of male flower; D, longitudinal section of female flower; E, cross section of anther (female flower); F, stigma of male flower; G, stigma of female flower. (A–C and F from *S 49967* (Sheet 1), D–E and G from *Nais et al. SNP 4891.*)

6. **Heliciopsis rufidula** Sleumer

(Latin, *rufidulus* = somewhat red; the indumentum of young leaves, branches, rachis)

Blumea 8 (1955) 82, FM 1, 5 (1955) 192; Kochummen *l.c.* 319; Anderson *l.c.* 289; Ashton *l.c.* 337; Whitmore, Tantra & Sutisna *l.c.* 293; Turner *l.c.* 409; PROSEA *l.c.* 287. **Type:** *Browne FMS 43457*, Peninsular Malaysia, Perak, Trolak FR (holotype KEP!).

Tree to 30 m tall, 60 cm diameter. **Bark** hoop-marked. **Sapwood** white. **Twigs** terete, grey to dull brown, initially reddish-brown hairy, glabrescent. **Unlobed leaves** *thinly coriaceous*, *dark brown when dry*, slightly shining above, *initially covered with crisp reddish-brown hairs on both surfaces*, *glabrescent*; *obovate* or *broadly obovate-oblong*, (*12–*)*15–28* × (*6–*)*7–13 cm*, base cuneate, margin entire, *apex broadly rounded*; midrib slightly raised above, prominent below, hairy; lateral veins 14–18 pairs, straight and parallel, inarching near leaf margin, visible above, prominent below, hairy; intercostal venation visible on both surfaces; petiole (1–)1.5–3 cm long, 1–2 mm thick, initially reddish-brown hairy, soon-glabrescent. **Deeply lobed leaves** *c.* 55 × 35 cm, with 3–4 lobes on each side, 12–18 × 5–8 cm, densely dark reddish-brown hairy below, 4–6 cm from common midrib; lateral veins 10–12 pairs; petiole to 11 cm long, 4–6 mm thick, dark reddish-brown hairy. **Inflorescences** (immature) borne on leafless older branches, solitary, 8–15 cm long, laxly flowered except for 3.5–8 cm from base; rachis 1.5–2 mm diameter, densely reddish-brown hairy; bracts linear, 2.5–3 mm long, persistent, reddish-brown hairy. **Flowers** (immature)**:** pedicels 1.5–2 mm long, in pairs, connate to halfway from base, reddish-brown hairy; perianth 4–5 mm long, reddish-brown hairy, limb clavate, *c.* 1.5 mm diameter; male flower with anthers 1.5 mm long; female flower with ovary ovoid, glabrous. **Fruits** *broadly ellipsoid*, 3.5–4 × 2.5 cm, smooth, *not shining black when dry*; *exocarp* leathery, *0.5–1 mm thick*; *mesocarp made up* of radial, soft brown *fibres c. 1 mm long*; *endocarp c. 1 mm thick*; stalks 7–9 mm long, 2–2.5 mm thick, persistent.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon, known only from one collection, *Jacobs 5406*, from Belaga, Kapit, Sarawak.

Ecology. Lowland mixed dipterocarp forest on clay-rich soils, at about 500 m altitude.

7. **Heliciopsis velutina** (Prain) Sleumer Fig. 11.

(Latin, *velutinus* = velvety; the petiole)

Blumea 8 (1955) 81, FM 1, 5 (1955) 191; Kochummen, TFM 2 (1973) 320; Anderson *l.c.* 289; Cockburn *l.c.* 78; Ashton *l.c.* 338; Whitmore, Tantra & Sutisna *l.c.* 293; Turner *l.c.* 409; PROSEA *l.c.* 287. **Basionym:** *Helicia velutina* Prain, Kew Bull. (1912) 343. **Type:** *Kunstler 7316*, Peninsular Malaysia, Perak, Larut, G. Bubu (holotype K!).

Tree, 10–25 m tall, 20–25 cm diameter. **Bark** dark brown with grey patches, smooth to cracked, with horizontal rings; inner bark pinkish brown, fibrous. **Sapwood** white. **Twigs** terete, greyish brown, initially reddish-brown hairy, soon-glabrescent. **Unlobed leaves** *thinly coriaceous*, *olivaceous*, *greenish* or *yellowish brown when dry*, slightly shining above, *glabrous*; *lanceolate* or *oblanceolate-oblong*, (10–)12–28 × (3–)4–7 cm, *base cuneate*, *non-decurrent*, margin entire, *apex short-acuminate* or *subacute*; midrib raised above, prominent below, pubescent on both surfaces, soon-glabrescent; *lateral veins 12–14*(*–16*) *pairs*, rather straight below and parallel to each other, curved above and inarching, with some short and less distinct intermediate

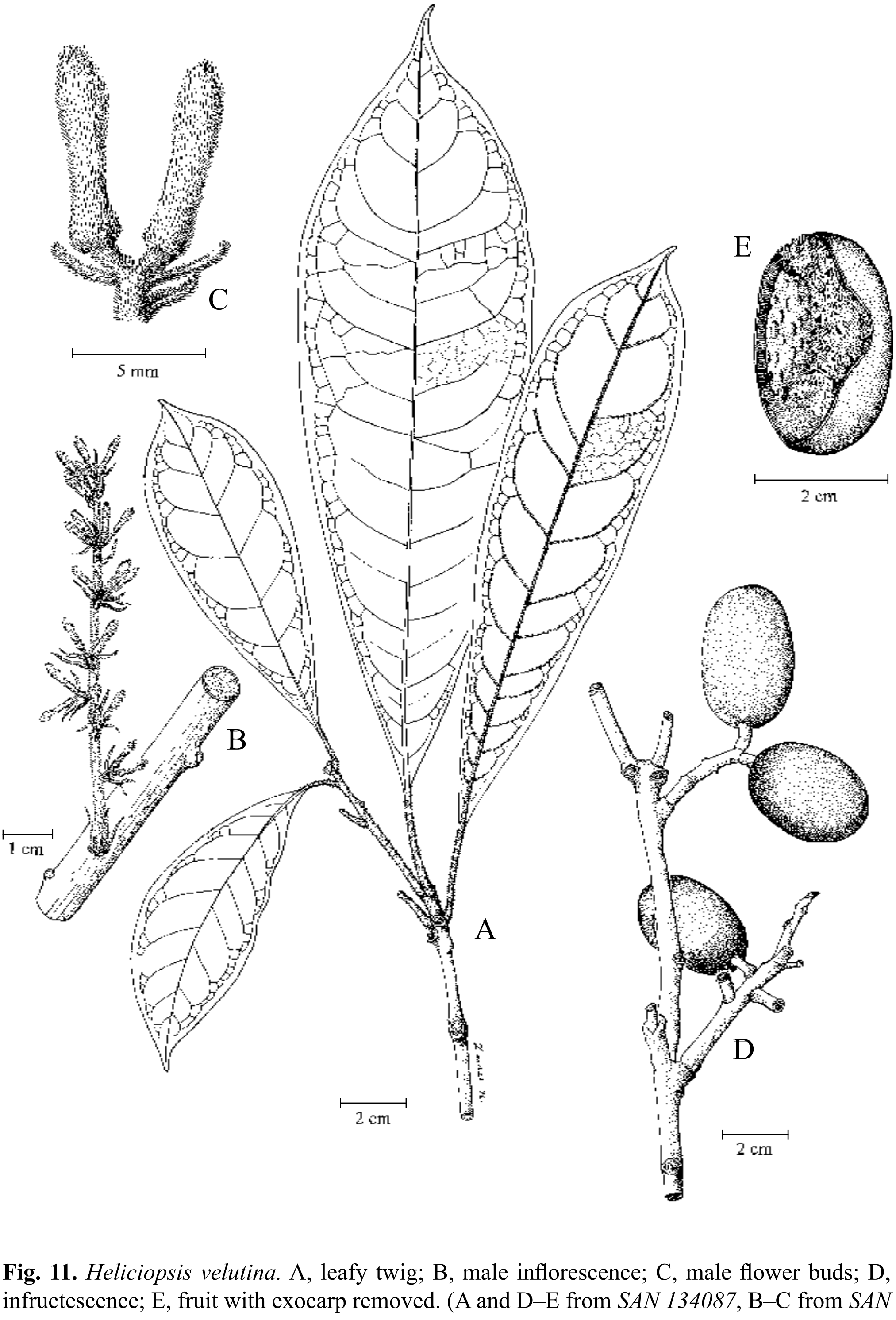

Fig. 11. *Heliciopsis velutina.* A, leafy twig; B, male inflorescence; C, male flower buds; D, infructescence; E, fruit with exocarp removed. (A and D–E from *SAN 134087*, B–C from *SAN 91494.*)

veins between lateral veins, visible above, prominent below; intercostal venation visible to inconspicuous on both surfaces; *petiole 1.5–2*(*–3*) *cm long*, 1–2 mm thick, slightly swollen at base, greenish brown when dry, initially reddish-brown hairy, late-glabrescent. **Deeply lobed leaves** unknown. **Inflorescences** axillary or borne on leafless older branches, solitary or rarely in pairs, (6–)7–12 cm long, densely flowered except for 1–2 cm from base; rachis *c.* 1.5 mm diameter in male inflorescences and 2–2.5 mm diameter in female inflorescences, reddish-brown hairy; bracts linear, (6–)8–10 mm long, persistent, reddish-brown hairy. **Flowers:** pedicels 4–5 mm long, mostly in pairs, free or connate to 2–2.5 mm from base, reddish-brown hairy; perianth 10–12 mm long, reddish-brown hairy, glabrescent on top, limb clavate, 2–2.5 mm diameter; male flower with anthers *c.* 2 mm long; female flower with ovary narrowly ovoid, glabrous; disk-glands broadly obovate-truncate, free, slightly distant from each other. **Fruits** *cylindric-ellipsoid*, 3–4 × 2–2.5 cm, smooth, not shining, *brown when dry*; *exocarp* leathery, *1–1.5 mm thick*; *mesocarp made up* of radial, soft brown *fibres of 2–3 mm long*; *endocarp* hard, woody, *1–2 mm thick*; stalks 8–10 mm long, *c.* 3 mm thick, persistent.

Vernacular name. Sarawak—*palis* (Iban).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from a few collections (e.g., *Elmer 21674*, *SAN 15232*, *SAN 38270*, *SAN 72476*, *SAN 78559*, *SAN 91494*, and *SAN 134087*), and in Sarawak, uncommon (*S 36740* and *S 44647*). Also known from Brunei (e.g., *BRUN 3186*) and Kalimantan (e.g., *Church & Mahyar 1848*, *Kostermans 4364* and *van Balgooy & van Setten 5630*).

Ecology. In lowland mixed dipterocarp forest on well-drained sandy-clay or leached clay soils, at altitudes to 600 m.

SAPOTACEAE

P.P.K. Chai[1] **& P.C. Yii**[2]

With contributions by A.P. Abang Mohd. Mohtar[1] (*Palaquium*),
L.C.J. Julaihi[1] (*Chrysophyllum*, *Isonandra* and *Mimusops*),
M. Mohizah[1] (*Aulandra* and *Diploknema*), A. Noorsiha[3] (*Sarcosperma*),
J.T. Pereira[4] (*Payena*), and Stephen P. Teo[1] (*Pouteria*)

Jussieu, Gen. Pl. (1789) 151; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 157; Ridley, FMP 2 (1923) 256; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 1, *ibid.* 3, 8 (1927) 381; Merrill, EB (1921) 476, PEB (1929) 238; H.J. Lam & Varossieau, Blumea 3 (1938) 184; Masamune, EPB (1942) 587; Jeuken, Blumea 6 (1952) 547; H.J. Lam & P. Royen, Blumea 7 (1952) 148; Van den Assem, Blumea 7 (1953) 364; Wyatt-Smith, FRI Res. Pamp. 4 (1954) 1; Browne, FTSB (1955) 320; Vink, Blumea 9 (1958) 21; P. Royen, Blumea 9 (1958) 75, *ibid.* 10 (1960) 1 & 432; Kochummen & Wyatt-Smith, Mal. For. Rec. 17 (1964) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 189; Burgess, TBS (1966) 447; Sinclair, Gard. Bull. Sing. 22 (1967) 227; Keng, OFMSP (1969) 225; Ng, TFM 1 (1972) 388; Anderson, CLTS (1980) 314; Corner, WSTM 3rd edition 2 (1988) 690; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315; Pennington, Gen. Sapot. (1991) 1; Brummitt, Vasc. Pl. Fam. & Gen. (1992) 662; Kessler & Sidiyasa, TBSA-EK (1994) 211; Turner, Gard. Bull. Sing. 47 (1995) 462; Coode *et al.* (eds.), CLBD (1996) 305; Argent *et al.* (eds.), MNDT-CK 2 (1997) 574.

Trees or shrubs. Latex present, white or yellowish. Indumentum always present on young parts. **Stipules** present, caducous, or absent (*Chrysophyllum* and *Pouteria*). **Leaves** simple, spirally arranged and frequently crowded at end of twigs, or alternate and distichous, or rarely opposite or subopposite; margin entire or very rarely erose (gnawed), plane or revolute; petiole rarely bearing a pair of minute stipels (*Sarcosperma*). **Inflorescences** fasciculate, or flowers rarely solitary, in axils of leaves or leaf scars, or borne on older leafless branches or stems, occasionally paniculate and borne on leafless axillary short shoots (brachyblasts). **Flowers** bisexual, rarely unisexual (plants monoecious or dioecious), radially symmetrical; sepals either in a single whorl of (4–)5(–11), or in two whorls of 2, 3 or 4, free or partly fused at base; corolla rotate, cyathiform or tubular, tube shorter, equal or exceeding the lobes, lobes 4–18, each lobe entire or divided into 3 segments, with the median segment entire and two lateral ones entire, laciniate or shallowly or deeply lobed; stamens either of the same number as corolla lobes and opposite them or numerous and arranged in one, two or three whorls, inserted at the base or at the throat of corolla tube, exserted or included; filaments geniculate in bud, free or rarely fused into staminal tube; anthers dehiscing extrorsely, introrsely or laterally; staminodes if present, alternating with stamens or fixed in the sinuses of corolla lobes; ovary superior, 3–18-loculed, each locule with one anatropous to hemianatropous ovule, style simple, exserted or included, stigma small and indistinct, simple or minutely lobed. **Fruit** a fleshy berry, rarely a drupe or a loculicidal capsule, with persistent sepals at base and style at tip. **Seeds** 1–10, ovoid to ellipsoid, often laterally

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compressed; testa glossy, brown to black; scar adaxial, basi-ventral or basal, narrow or broad, occasionally covering most of seed surface; cotyledons thin and foliaceous, or flat and thick or plano-convex; endosperm present or absent.

Distribution. About 53 genera and 1100 species, mostly in the humid tropics and subtropics, but some genera extending to semi-arid and arid areas. In Sabah and Sarawak, the family is represented by 11 genera and 121 species comprising 118 native, 1 incompletely known and 2 introduced species.

Ecology. One of the common components of the lowland forest, occurring from beach forest at sea level to mossy montane forest, at altitudes to 4000 m.

Uses. Timber is classified into 2 main groups. *Bitis* or *nyatoh temiang* is a name given to the heavy hardwood of some species that is extremely strong and durable. It seasons badly with high shrinkage, resulting in both surface and end checking. It is strong and resistant to attack by powder-post beetles. It contains silica; grain is straight and slightly interlocked, hard to work; texture is fine and even, and it planes and turns to a very fine finish. Sapwood is paler and less durable than heartwood; heartwood is reddish brown, hard, heavy and durable, suitable for heavy structural and general construction work. *Nyatoh* is the other group that is much lighter and more commonly available than *bitis* or *nyatoh temiang*. It is moderately hard and heavy. It is resistant to preservatives but is moderately durable when used indoors. It has fine and even texture with interlocked and wavy grains, suitable for solid doors and veneer and plywood. Gutta percha, a latex obtained by tapping Sapotaceae trees, contains isoprene and caoutchine. The latex was used for insulating telegraph cables before the invention of plastic. Other uses include surgical and chemical apparatus, corks, golf-balls and dental filling. The flowers of *Madhuca longifolia* and *M. latifolia* are rich in nectar. The nectar has been used for sweetening food, extracting sugar and even for making fermented liquors and acetone. In Sarawak, fat extracted by crushing kernels of *Madhuca motleyana* and other species is used for cooking by local people. Similarly, in India, fat extracted from kernels of *M. latifolia* and *M. longifolia* is used as substitute for ghi, for making soap and candle-wax. Fruits of *Manilkara zapota* (L.) P.Royen, *Chrysophyllum cainito* L. and several species of *Madhuca* are edible.

Taxonomy. Together with the Ebenaceae, Styracaceae and Symplocaceae, Sapotaceae are included in the order Ebenales. Members of the Sapotaceae are easily distinguished from those of other families within the Ebenales by the presence of free flowing rubbery white or yellowish latex in the bark, leaves, flowers and fruits. However, the genera are difficult to define without taking floral characters into consideration. The present delimitation of genera is based on Pennington's monograph (*l.c.*).

Key to genera

1. Sepals in a single whorl of 4–6 2
   Sepals in two whorls of 2, 3 or 4 6

2. Stipules present……………………………………………………………3
Stipules absent……………………………………………………………5

3. Leaves usually opposite or subopposite, often with glandular pits in axils of lateral veins; petiole often with stipels at distal end. Inflorescences racemose or paniculate……. …….
………………………………………………………………………**11. Sarcosperma**
Leaves usually spirally arranged or alternate and distichous, without glandular pits in axils of lateral veins; petiole without stipels at distal end. Inflorescences 1–many-flowered fascicles, in axils of leaves or leaf scars on leafless older twigs or rarely borne on leafless axillary short shoots (brachyblasts)……………………………………4

4. Stipules large and persistent. Inflorescences axillary. Corolla lobes 5, each lobe divided into 3 segments; stamens 5; staminodes much longer than stamens, with distinct sagittate appendages at apex. Fruits constricted between seeds……**4. Eberhardtia**
Stipules small and caducous. Inflorescences borne in axils of leaf scars on leafless older twigs. Corolla lobes 8–16, each lobe not divided into segments; stamens (10–)16–30(–80); staminodes shorter than stamens, without sagittate appendages. Fruits not constricted between seeds……………………………………………………………**3. Diploknema**

5. Leaves alternate and distichous or rarely spirally arranged along twigs; lateral veins dense and numerous; intercostal venation descending from leaf margin and parallel to lateral veins. Staminodes usually absent or rarely present as small subulate vestigial structures………………………………………………………**2. Chrysophyllum**
Leaves spirally arranged; lateral veins well-spaced; intercostal venation reticulate or subscalariform. Staminodes (4–)5(–6), rarely absent…………………**10. Pouteria**

6. Sepals in two whorls of 2…………………………………………………………7
Sepals in two whorls of 3 or 4……………………………………………………9

7. Leaves alternate and distichous on horizontal shoots; intercostal venation descending from leaf margin and parallel to lateral veins, and branching out towards midrib………
…………………………………………………………………………………**9. Payena**
Leaves spirally arranged; intercostal venation subscalariform, oblique, reticulate-tessellate or rarely descending from leaf margin and parallel to lateral veins……………8

8. Flowers subsessile; corolla tube glabrous at the throat, lobes 4(–5); stamens 8–10; ovary 4–5-loculed……………………………………………………………**5. Isonandra**
Flowers distinctly pedicellate; corolla tube hirsute or barbate at the throat, lobes 6–17; stamens 12–43; ovary 4–15-loculed………………………………**6. Madhuca**

9. Sepals in two whorls of 3 or 4; petals (6–)8, each lobe divided into 3 segments; stamens (6–)8; staminodes (6–)8………………………………………………………10
Sepals in two whorls of 3; petals 5–6, each lobe not divided into segments; stamens (10–)12(–30); staminodes absent………………………………………………………11

10. Sepals in two whorls of 4; petals 8; stamens and staminodes usually 8; staminodes hairy. Seed scar small and mostly basal. Indigenous forest trees…………**7. Mimusops**

Sepals in two whorls of 3; petals, stamens and staminodes usually 6; staminodes glabrous. Seed scar elongate, basi-ventral. Introduced cultivated trees…..……………..

Manilkara zapota (L.) P.Royen
(Latinised abbreviation of a Mexican plant name—*cochit-zapotl*)
Blumea 7 (1953); Pennington *l.c.* 135. Basionym: *Achras zapota* L., Sp. Pl. 2 (1753) 1190.
Native of C America, Mexico and West Indies. Widely cultivated in the tropics for its fruits.
Tree to 30 m tall; trunk with low branches; crown dense, globose; all parts rich in white and gummy latex. Leaves spirally arranged and crowded at apex of twigs; lateral veins numerous, parallel. Flowers bisexual, solitary in axils of upper leaves; calyx deeply 6-lobed, *lobes in two whorls of 3*; corolla campanulate, *6-lobed*, lobes about half as long as tube; *stamens 6*, *staminodes 6*, petaloid; ovary 10–12-loculed, style subulate, exserted. Fruit a pendulous berry, globose, ovoid or ellipsoid, 3–8 × 3–6 cm, 6–12-seeded; rind thin, dull reddish to yellowish brown, covered with sandy brown scurf; mesocarp fleshy, juicy, yellow to red-brown, sweet. Seeds asymmetrically ovoid, laterally compressed, brown or black, *scar basi-ventral*.

11. Inflorescences 1–many-flowered fascicles, borne in axils of leaves or leaf scar. Filaments of stamens free or only partially united at base……………**8. Palaquium**
Inflorescences few-flowered fascicles, borne terminally on brachyblasts. Filaments of stamens united for about half of their length or more into a staminal tube…………………………………………………………………………………………**1. Aulandra**

1. **AULANDRA** H.J.Lam

(Greek, *aulos* = tube, *andrus* = male; the well-developed staminal tube)

M. Mohizah

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 415; Masamune, EPB (1942) 587; P. Royen, Blumea Suppl. 4 (1958) 263; Anderson, CLTS (1980) 314; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315; Pennington, Gen. Sapot. (1991) 152; Coode *et al.* (eds.), CLBD (1996) 305.

Trees. **Stipules** present, small, caducous. **Leaves** spirally arranged, without glandular pits in axils of lateral veins; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation dense, obliquely subscalariform; petiole without stipels at distal end. **Inflorescences** *few-flowered fascicles borne terminally on densely scaly*, *simple or branched brachyblasts up to 3 cm long*. **Flowers** bisexual; *sepals 6*, *in two whorls of 3*, free or united at base, lobes of outer whorl more or less valvate; *petals 6*, glabrous, fused at base, *free lobes not divided into segments*, contorted or imbricate, spreading or reflexed, exceeding corolla tube; *stamens 18–19*, in a single whorl, inserted at top of corolla tube, exserted, *filaments united for about half of their length or more into a staminal tube*, anthers extrorse, hairy, *staminodes absent*; disk (nectary) absent; ovary 6–7-loculed, styles filiform, exserted, ovules anatropous. **Fruits** 1-seeded. **Seeds** broadly ovoid with a broad adaxial scar covering about two thirds of its surface; cotyledons plano-convex; endosperm absent.

Distribution. Two species, endemic to Borneo (Sarawak and Kalimantan).

Taxonomy. *Aulandra* is closely related to *Palaquium* but can be distinguished by its cauliflorous or ramiflorous habit, flowers that are borne terminally on a brachyblast and by the filaments which are fused for about half of their length or more into a staminal tube.

Key to *Aulandra* species

Leaves well-spaced along twigs, coriaceous, obovate-elliptic, 23–30 × 5–9.5 cm; lateral veins 9–15 pairs, ascending at an angle of 50–55° from midrib. Stipules *c.* 1.5 × 1 mm. Brachyblasts up to 1 cm long. Anthers cordate-sagittate, 1–1.5 mm long. Ovary subconical, style subulate, *c.* 2 mm long………………..………………………..……….…….**1. A. beccarii**

Leaves clustered near ends of twigs, chartaceous to subcoriaceous, oblanceolate or obovate-oblong, 32–97 × 7–28 cm; lateral veins 22–40 pairs, ascending at an angle of 60–80° from midrib. Stipules 2–3 × 1–1.5 mm. Brachyblasts up to 3 cm long. Anthers lanceolate-oblong, 2–3 mm long. Ovary ovoid-globose, style filiform, 4–9.5 mm long……......**2. A. longifolia**

1. **Aulandra beccarii** (Pierre *ex* Dubard) P.Royen

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Blumea Suppl. 4 (1958) 263; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 152. **Basionym:** *Palaquium beccarii* Pierre *ex* Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 20. **Type:** *Beccari PB 3347*, Borneo, Sarawak, Bt. Balang, Batang Lupar (holotype P; isotypes K, L).

Small tree. **Twigs** stout, angular, reddish-brown tomentose, glabrescent. **Terminal buds** to 5 mm long, greyish-brown tomentose. **Stipules** lanceolate, *c. 1.5 × 1 mm*, reddish-brown tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, glabrous on both surfaces except for the sparsely tomentose basal part of midrib above and along midrib below, *coriaceous*; *obovate-elliptic*, *(17–)23–30 × (5–)7.5–9.5 cm*, base cuneate and slightly decurrent, apex acuminate with an obtuse acumen to 12 mm long; midrib prominently crested on both sides; *lateral veins 9–15 pairs*, *ascending at an angle of 50–55° from midrib*, impressed above, prominent below; intercostal venation slender, obscure above, prominent below; petiole 1.5–5 cm long, flat on adaxial side, reddish-brown tomentose, glabrescent. **Inflorescences:** *brachyblasts to 1 cm long*, with numerous bract-scars; bracts deltoid, *c.* 1.5 × 1 mm. **Flowers** pale yellow; pedicel angular, 2–5.5 mm long, reddish-brown tomentose; outer sepals ovate, 2.5–3 × 2–2.5 mm, inner sepals elliptic-ovate, slightly smaller than outer ones; corolla to 3 mm long in bud, lobes oblong, *c.* 2.5 × 1 mm, glabrous; stamens 18, staminal tube 1.5–2 mm long, free filaments subulate, *c.* 0.3 mm long, *anthers cordate-sagittate*, *1–1.5 mm long*; *ovary subconical*, *c.* 0.5 × 1 mm, reddish-brown pubescent at apex, glabrous at base, *style subulate*, *c. 2 mm long* with 6 longitudinal slits, glabrous except for scattered hairs at apex. **Fruits** unknown.

Distribution. Endemic to Borneo. So far only known from the type collection (*Beccari PB 3347*) from Sarawak.

2. **Aulandra longifolia** H.J.Lam Fig. 1.

(Latin, *longus* = long, *folium* = leaf; with long leaves)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 415; Masamune *l.c.* 587; P. Royen, Blumea Suppl. 4 (1958) 266; Anderson *l.c.* 314; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 153; Coode *et al.* (eds.) *l.c.* 305. **Type:** *Amdjah 238*, Borneo, Kalimantan, Lumbis (holotype BO; isotype L). **Synonym:** *A. cauliflora* H.J.Lam *in* Hooker, Icon. Pl. (1938) 3360, Pennington *l.c.* 153.

Tree to 20 m tall, 25 cm diameter. **Bark** smooth to slightly fissured, greyish brown. **Twigs** stout, glabrous. **Stipules** lanceolate, *2–3 × 1–1.5 mm*, reddish-brown tomentose outside, glabrous inside. **Leaves** *clustered near ends of twigs*, sparsely reddish-brown tomentose, glabrescent; *chartaceous* to *subcoriaceous*; *oblanceolate* or *obovate-oblong*, (*24–*)*32–97* × (*4.5–*)*7.2–28 cm*, base attenuate, decurrent, apex short-acuminate; midrib slightly impressed above, prominently raised below; *lateral veins 22–40 pairs*, *ascending at an angle of 60–80° from midrib*, impressed above, prominent below; intercostal venation faint above, distinct below; petiole 2–8.5 cm long, flat on adaxial side, rugulose at basal part. **Inflorescences:** *brachyblasts to 3 cm long*, branched and covered with scars; bracts ovate-triangular, *c.* 1.5 mm long. **Flowers:** pedicel angular, reddish-brown tomentose, 4–8 mm long; sepals ovate-lanceolate, crested, outer sepals 2–6 × 2–3.5 mm, tomentose, inner sepals 4.5–5 × 2–2.5 mm, glabrous; corolla white to creamy, 6–8.5 mm long, glabrous, lobes ovate, obovate or spathulate, 5–6.5 × 2–4 mm; stamens 18–19, staminal tube 2.5–3.5 mm long, free filaments 1.5–4 mm long, *anthers lanceolate-oblong*, *2–3 mm long*, glabrous but with reddish brown hairs when young; *ovary ovoid-globose*, *c.* 1.5 × 2 mm, *style filiform*, glabrous, *4–9.5 mm long*. **Fruits** ovoid to subglobose, slightly oblique, 2–3.5 × 2–3 cm, acute with remnant of style at apex; pericarp woody, thin, glabrous. **Seeds** pear-shaped, 1.5–1.8 × 0.6–0.8 cm, obtusely acuminate at apex, rounded at base; scar large, covering about three-fourths of seed surface.

Vernacular name. Sarawak—*palawak* (Murut).

Distribution. Endemic to Borneo. Scattered throughout Sarawak (e.g., *S 13978*, *S 23308*, *S 28156*, *S 36090*, *S 46644*, and *S 52041*). Also known in Brunei and Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forest, at altitudes to 1000 m.

2. **CHRYSOPHYLLUM** L.

(Greek, *chrusos* = golden, *phullon* = leaf; the golden coloured leaf under surface)

L.C.J. Julaihi

Sp. Pl. 1 (1753) 192; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 158; Merrill, EB (1921) 483; Ridley, FMP 3 (1923) 257; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 186, *ibid.* 3, 8 (1927) 466; Masamune, EPB (1942) 587; Vink, Blumea 9 (1958) 21; Backer & Bakhuizen *f.*, FJ 2 (1965) 154; Burgess, TBS (1966) 447; Ng, TFM 1 (1972) 395; Anderson, CLTS (1980) 314; Corner, WSTM 3rd edition 2 (1988) 692; Whitmore, Tantra & Sutisna, CLK 2,1 (1990) 316; Pennington, Gen. Sapot. (1991) 216; Argent *et al.* (eds.), MNDT-CK 2 (1997) 574. **Synonym:** *Nycterisition* Ruiz & Pavon, Prod. (1794) 30.

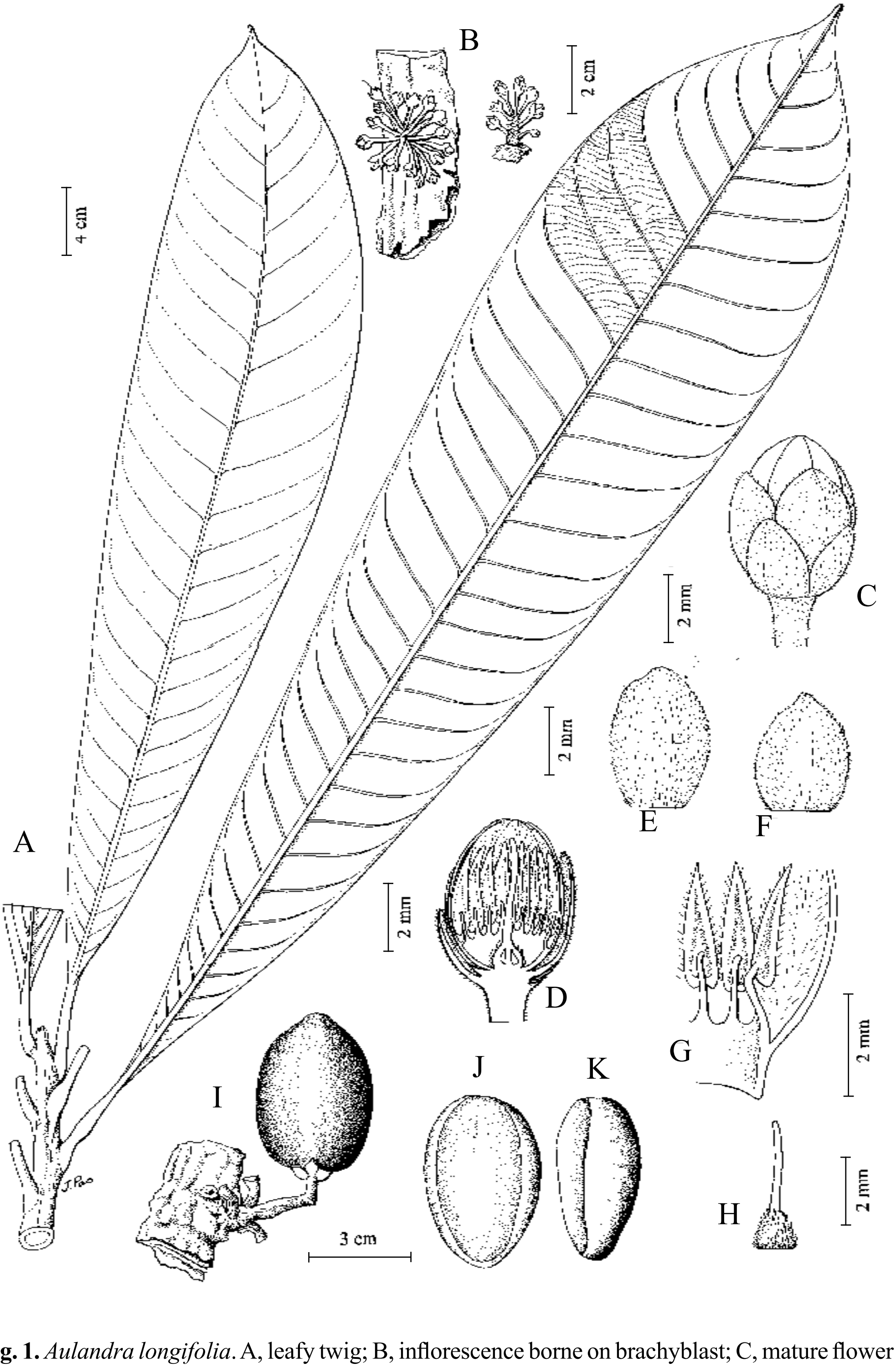

Fig. 1. *Aulandra longifolia*. A, leafy twig; B, inflorescence borne on brachyblast; C, mature flower bud; D, longitudinal section of mature flower bud; E, inner sepal; F, outer sepal; G, stamens; H, gynoecium; I, infructescence with one mature fruit; J, seed in ventral view showing the broad scar; K, seed in side view. (A–H from *S 28156*, I–K from *S 29662*.)

Trees or shrubs. **Stipules** *absent.* **Leaves** *alternate and distichous* or *rarely spirally arranged along twigs*, without glandular pits in axils of lateral veins; *lateral veins dense and numerous*, diminishing and becoming inconspicuous towards leaf margin or arching and joining to form a smooth intramarginal vein or vein-loops; *intercostal venation descending from leaf margin and parallel to lateral veins* or reticulate. **Inflorescences** 1–many-flowered fascicles, axillary or borne on leafless older branches. **Flowers** unisexual or bisexual; *sepals* (*4–*)*5*(*–6*), *in a single whorl*, imbricate; corolla campanulate or tubular, lobes (4–)5(–8), each lobe not divided into segments, shorter, equal or slightly exceeding the length of corolla tube, erect or slightly spreading; stamens (4–)5(–8), inserted on the throat of corolla tube, anthers extrorse; *staminodes absent* or *rarely present as small subulate vestigial structures* located in corolla lobes' sinuses, alternating with stamens; disk (nectary) absent; ovary (4–)5(–12)-loculed, villous or glabrous, style included. **Fruits** 1–many-seeded; pericarp thin. **Seeds** ellipsoid, laterally compressed; scar narrow, adaxial; cotyledons thin foliaceous or thick and flat; endosperm abundant.

Distribution. About 43 species, distributed in C America, C Africa, Madagascar, India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Pacific Islands, and Australia. One indigenous species, *C. roxburghii*, occurs in Sabah and Sarawak; another species, *C. cainito*, has been introduced and cultivated for its fruits.

Key to *Chrysophyllum* species

Leaves glabrous on both surfaces, apex acute to acuminate, acumen 5–18 mm long; midrib prominent on both surfaces; petiole 0.3–0.7 cm long, flat or rounded on adaxial side, glabrous. Ovary subglobose, 5-ribbed. Fruits 5-ridged, 1.5–4 cm diameter. Indigenous forest tree……………………………………………………………**C. roxburghii**

Leaves densely reddish-brown hairy below, apex obtuse, short-acuminate, acumen to 8 mm long; midrib impressed above, raised below; petiole 0.9–2 cm long, reddish-brown tomentose, grooved on adaxial side. Ovary subconical, 7–10-ribbed. Fruits not ridged, *c.* 5.5 × 4 cm. Introduced cultivated tree…………………………………………………

C. cainito L.

(a West Indies plant name—*cainito* or *caimito*)

Sp. Pl. (1753) 192; H.J. Lam *l.c.* (1925) 188, *l.c.* (1927) 466; Corner *l.c.* 693; Vink *l.c.* 26; Backer & Bakhuizen *f.* 154; Ng *l.c.* 395; Whitmore, Tantra & Sutisna, CLS (1986) 217; Pennington *l.c.* 224. Type: unknown.

Native to tropical America, the species has been introduced and cultivated in Peninsular Malaysia, Java, Sabah, Sarawak, the Philippines and other tropical countries for its edible fruits.

Tree to 30 m tall, 40 cm diameter. *Leaves* chartaceous, *densely reddish-brown hairy* and shining below; elliptic to ovate, 6–11.5 × 3–6.5 cm, base broadly cuneate to rounded, *apex obtuse* to *short-acuminate*, *acumen to 8 mm long*; petiole 0.9–2 cm long, *reddish-brown tomentose*, *grooved on adaxial side*. Inflorescences 5–10-flowered; *ovary subconical*, *7–10-ribbed. Fruits* ovoid, *c. 5.5 × 4 cm*, *not ridged*; pericarp up to 10 mm thick, turning purplish black when ripe. Seeds ovoid to ellipsoid, 1.3–1.9 × 0.6–0.9 cm; testa light brown, shining.

Chrysophyllum roxburghii G.Don Fig. 2.

(W. Roxburgh, 1751–1815, Scottish botanist and physician, 1781–1793 superintendant of the Calcutta Botanic Garden, India)

Gard. Dict. 4 (1838) 33; King & Gamble *l.c.* 158; Ridley *l.c.* (1923) 257; H.J. Lam *l.c.* (1925) 187, *l.c.* (1927) 466; Masamune *l.c.* 587; Backer & Bakhuizen *f. l.c.* 154; Anderson *l.c.* 314; Turner, Gard. Bull. Sing. 47 (1995) 462. **Type:** unknown. **Synonyms:** *Nycterisition lanceolatum* Blume, Bijdr. Fl. Ned. Ind. 12 (1826) 676; *Chrysophyllum lanceolatum auct. non* Casar.: A.DC., Prodr. 8 (1844) 162, Merrill *l.c.* (1921) 483, Vink *l.c.* 28, Ng *l.c.* 395, Whitmore, Tantra & Sutisna *l.c.* 316, Pennington *l.c.* 221; *Lucuma lanceolata* (Blume) Zippel *in* Macklot, Bijdr. Natuurk. Wet. 5 (1830) 178.

Tree to 30 m tall, 40 cm diameter; bole usually fluted at base; buttresses small or absent. **Bark** smooth to shallowly fissured, grey to dark brown; inner bark pale brown. **Sapwood** yellowish. **Twigs** slender, terete, 1–4 mm thick, reddish-brown tomentose, glabrescent. **Leaves** chartaceous, *glabrous on both surfaces*; oblong, ovate or lanceolate, 5–15 × 2–6 cm, base cuneate, oblique, *apex acute* to *acuminate*, *acumen 5–18 mm long*; *midrib prominent on both surfaces*; lateral veins numerous, slender, closely parallel, arching and joining into intramarginal vein; intercostal venation descending from leaf margin and parallel to lateral veins, obscure on both sides; *petiole* slender, *0.3–0.7 cm long*, *flat* or *rounded on adaxial side*, *glabrous*. **Inflorescences** axillary, 5–45-flowered. **Flowers:** pedicel 0.3–0.6 cm long; sepals ovate, *c.* 0.8 × 0.7 mm; corolla 1.8–2.1 mm long, glabrous, tube 0.7–1.2 mm long, lobes ligulate to trapezoid; stamens 5, filaments slender, anthers ovoid; *ovary subglobose*, *c.* 0.6 × 0.9 mm, *5-ribbed*, reddish-brown villous, style cylindrical, *c.* 1.5 mm long, glabrous. **Fruits** globose, *1.5–4 cm diameter*, *5-ridged*, ripening yellow, brownish to purplish black when dry; pericarp thin. **Seeds** 5, obovoid, laterally compressed, 1.3–2.6 × 0.45–0.8 cm; testa brown; scar narrowly oblong to oblanceolate.

Vernacular names. Brunei—*nyatoh empelit*, *nyatoh entalit* (Iban).

Distribution. West coast of India, Sri Lanka, Myanmar, Thailand, Indo-China, Hainan, Hong Kong, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Papua New Guinea and surrounding islands, and the Solomon Islands. Rare and scattered in Sabah (e.g., *SAN 30879*, *SAN 53446*, *SAN 71153*, *SAN 83853*, and *SAN 138776*) and Sarawak (e.g., *S 28792*, *S 34650* and *S 45629*). Also occurs in Brunei and Kalimantan.

Ecology. Middle-storey trees, usually occur in lowland mixed dipterocarp forest on clay soils, from sea level to 700 m altitude.

Uses. Produces good quality white, fine grained and moderately hard *nyatoh* timber, suitable for interior construction and kris-scabbards. Fruits are edible.

3. **DIPLOKNEMA** Pierre

(Greek, *diplous* = double, *knemis* = shin plate; the arrangement of sepals)

M. Mohizah

Arch. Néerl. Sci. Exact. Nat. 19 (1884) 103; Merrill, EB (1921) 479; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 183, *ibid.* 3, 8 (1927) 463; Masamune, EPB (1942) 587; P. Royen, Blumea 9 (1958) 75; Ng,

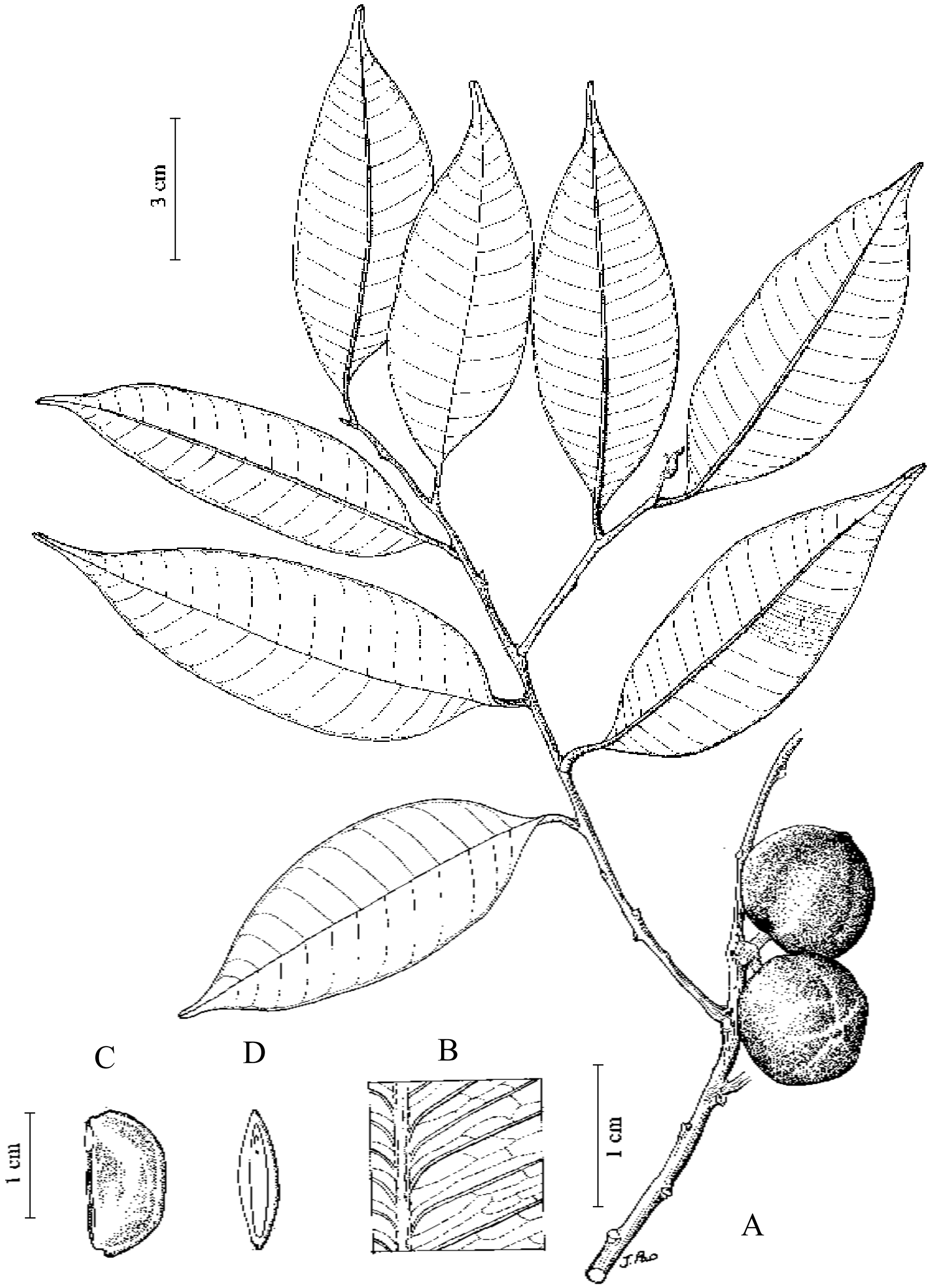

Fig. 2. *Chrysophyllum roxburghii*. A, fruiting leafy twig; B, detailed venation of leaf under surface; C, seed in side view; D, seed in ventral view showing the narrow seed scar. (A–B from *S 34650*, C–D from *SAN 83853*.)

TFM 1 (1972) 396; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 316; Pennington, Gen. Sapot. (1991) 162. **Synonym:** *Aesandra* Pierre, Not. Bot. Sapot. (1890) 1, van Bruggen, Blumea 9 (1958) 139.

Trees. **Stipules** *present*, often *small and caducous*. **Leaves** *spirally arranged*, usually crowded near ends of twigs, *without glandular pits in axils of lateral veins*; lateral veins diminishing and becoming inconspicuous towards leaf margin or rarely arching and joining to form intramarginal vein-loops; intercostal venation obliquely subscalariform or reticulate; *petiole without stipels at distal end*. **Inflorescences** *1–many-flowered fascicles*, *borne in axils of leaf scars on leafless older twigs*. **Flowers** bisexual or rarely unisexual (plant dioecious); *sepals* (*4–*)*5*(*–6*), *in a single whorl*, *free* or *partly united at base*, imbricate, quincuncial; *corolla lobes 8–16*, *each lobe not divided into segments*, contorted, spreading or recurved, exceeding the length of corolla tube, corolla tube hairy or glabrous; *stamens* (*10–*)*16–30*(*–80*), in one or two dense whorls, inserted at top of corolla tube, filaments free or partially united in pairs or small bundles, anthers extrorse, tapering to an acute apex, hairy or glabrous; *staminodes* in female flowers sometimes reduced in size and petal-like, *shorter than stamens*, *without sagittate appendages*; disk (nectary) absent or rudimentary; ovary (5–)6–15-loculed, hairy or glabrous, style stout, truncate; placentation central or apical. **Fruits** 1–4(–5)-seeded, *not constricted between seeds*. **Seeds** large, ellipsoid or laterally compressed; scar broad or narrow, adaxial; cotyledons plano-convex or thin foliaceous; endosperm present or absent.

Distribution. About 10 species, distributed in the northern part of India, Nepal, Bhutan, Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia, Borneo, the Philippines, and Maluku. In Borneo, only one species is known from Sabah and Kalimantan.

Diploknema sebifera Pierre Fig. 3.

(Latin, *sebifer* = wax-bearing; referring to the seeds)

Arch. Néerl. Sci. Exact. Nat. 19 (1884) 103; Merrill *l.c.* (1921) 479; H.J. Lam *l.c.* (1925) 184, *l.c.* (1927) 463; Masamune *l.c.* 587; P. Royen *l.c.* (1958) 75; Ng *l.c.* 396; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 164; Turner Gard. Bull. Sing. 47 (1995) 463. **Type:** *Knappert s.n.*, Borneo, Kalimantan, Amuntai district (holotype L; isotype K).

Tree to 40 m tall, 60 cm diameter, slightly buttressed. **Bark** greyish brown, smooth, slightly fissured to slightly flaky; inner bark fibrous or laminated, pinkish. **Sapwood** pale yellow. **Twigs** usually brown hairy when young, ultimately glabrous. **Stipules** small, deltoid, *c*. 2.5 × 2.5 mm. **Leaves** coriaceous, glabrous; obovate, 3–25 × 1–8 cm, base narrowly cuneate, shortly decurrent, apex obtuse to cuspidate or bluntly pointed; midrib sunken above, raised below; lateral veins 8–19 pairs, ascending at an angle of 40–60° from midrib, slightly curving and diminishing toward leaf margin, slightly impressed above, prominent below; intercostal venation obliquely subscalariform, faint above, prominent below; petiole 2–4 cm long, glabrous, narrowly and shallowly grooved on adaxial side, thickened at base. **Inflorescences** 3–10-flowered, borne on prominent warts below leaves in axils of lanceolate bracts to 2 mm long. **Flowers** unisexual; pedicel angular, 2–5 mm long, reddish-brown tomentose; sepals 5, ovate to elliptic, 2.5–4 × 1–3 mm; corolla 3.5–5.5 mm long, lobes 11–12, spathulate, 2.5–3.5 mm long, tube 0.5–1 mm long; stamens (or petaloid staminodes) 16–20, in two whorls, filaments 2–3.5 mm long, with inner

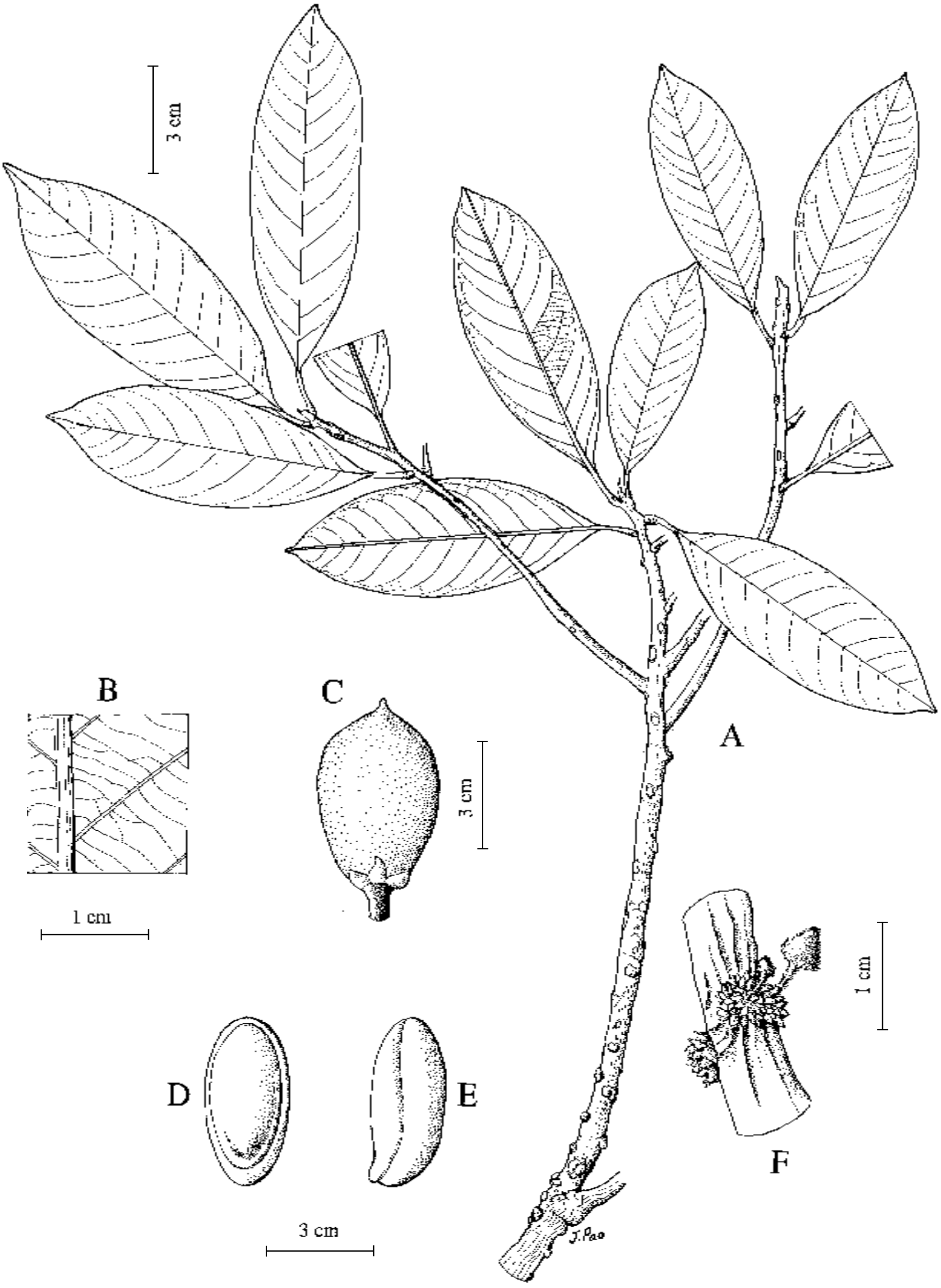

Fig. 3. *Diploknema sebifera*. A, leafy twig; B, detailed venation of leaf under surface; C, fruit; D, seed in ventral view; E, seed in side view; F, inflorescence. (A–E from *SAN 15547*, F from *Knappert s.n. = RHL Sheet No. 202390*.)

whorl longer; ovary (6–)7(–8)-loculed, *c.* 1.5 × 1 mm, reddish-brown sericeous, style angular, to 4 mm long, stigma cup-shaped, *c.* 1.5 mm diameter; ovules campylotropous. **Fruits** ellipsoid, 3.5–6 × 1.4–2 cm, apex acuminate with an obtuse tip, 1–4-seeded, brownish floss, glabrescent. **Seeds** obovoid, apex obtuse, base acute; scar covering almost half of the seed.

Distribution. Endemic to Borneo. In Sabah, known only from Sandakan and Lahad Datu districts (e.g., *SAN 15547*, *SAN 27022*, *SAN 36662*, *SAN 76048*, and *SAN A 3135*). Also known from Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Uses. *Tengkawang* oil extracted from the seeds contains glycerin of stearic, palmitic and oleic acids. It is used by local people for cooking.

4. **EBERHARDTIA** Lecomte

(A.G. Eberhardt, German botanist)

P.C. Yii & P.P.K. Chai

Bull. Mus. Hist. Nat., Paris 26 (1920) 345; P. Royen, Blumea 10 (1960) 118; Pennington, Gen. Sapot. (1991) 145.

Trees. **Stipules** *present*, *large*, *persistent*. **Leaves** *spirally arranged*, *without glandular pits in axils of lateral veins*; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation obliquely scalariform or reticulate-areolate; *petiole without stipels at distal end*. **Inflorescences** *1–many-flowered fascicles*, *axillary.* **Flowers** bisexual; *sepals 5*, more or less free, *in a single whorl*, quincuncial; *corolla lobes 5*, *each lobe divided for about two thirds of its length into 3 segments*, with median segment linear or narrowly subulate, and lateral segments broader and longer than median one, corolla tube equal or slightly shorter than lobes; *stamens 5*, in a single whorl, inserted at top of corolla tube; filaments short, free, anthers glabrous, laterally dehiscent; *staminodes 5*, alternating with stamens, *exceeding stamens*, narrowly lanceolate, glabrous, *bearing a large sagittate*, *caducous appendage at apex*; ovary 5-loculed, hairy or glabrous, style included. **Fruit** a loculicidal capsule, 3–5-seeded, *constricted between seeds*. **Seeds** ellipsoid, laterally compressed; scar narrow or broad, adaxial; cotyledons thin, foliaceous; endosperm copious.

Distribution. Three species, distributed in China, Vietnam, Laos and Borneo; 1 species occurs in Sabah.

Taxonomy. *Eberhardtia* is closely related to *Manilkara* Adans. and *Mimusops* L. but differs from both by the corolla lobes which are each dissected into 3 segments. It can be distinguished from other Bornean genera by its sagittate appendages on the staminodes, and by its fruit that is few-seeded and constricted between seeds.

Eberhardtia aurata (Pierre *ex* Dubard) Lecomte Fig. 4.

(Latin, *auratus* = flecked with gold; the colour of the indumentum)

Bull. Mus. Hist. Nat., Paris 26 (1920) 348; P. Royen *l.c.* (1960) 121; Pennington *l.c.* 146. **Basionym:** *Planchonella aurata* Pierre *ex* Dubard, Notul. Syst. 2 (1911) 1344. **Type:** *Balansa 4338*, Indo-China, Tonkin, Mt. Bluir, alt. 1400 m (holotype P). **Synonym:** *Pouteria aurata* (Pierre *ex* Dubard) Baehni, Candollea 9 (1942) 415.

Tree to 8 m tall. **Twigs** stout, ridged, 10 mm thick, densely rusty-brown pubescent, ultimately glabrous; terminal buds to 10 mm long, rusty-brown tomentose. **Stipules** lanceolate and slightly oblique, *c.* 9 × 2.5 mm, apex acuminate, crested and rusty-brown pubescent outside, glabrous inside. **Leaves** coriaceous, glabrous above except along midrib, densely rusty-brown pubescent below; oblong-obovate, 12–25 × 5–8.5 cm, base cuneate, margin entire, apex rounded-emarginate or broadly acuminate with an acumen to 1.5 cm long; midrib crested and prominent above, rounded below; lateral veins 16–18 pairs, ascending at an angle of 60–70° from midrib, curved and stronger near leaf margin, faint above, prominent below; intercostal venation faint on both sides; petiole stout, 2–3.5 cm long, angular, pubescent or subglabrous. **Inflorescences** and **flowers** unknown. **Fruits** subglobose 2.5–4.5 × 1–5 cm, 5-seeded; pericarp rusty-brown pubescent. **Seeds** ellipsoid, 2–4 × 1 cm, obtuse at both ends; scar linear; cotyledons elliptic.

Distribution. Southern China, Indo-China and Borneo. In Sabah, only known from three collections (*SAN 66309*, *Soepadmo et al. FRI 41348* and *Zainuddin et al. AZ 5024*).

Ecology. Rare in mossy montane forest and in forest on ultramafic soils.

5. **ISONANDRA** Wight

(Greek, *iso* = equal, *andro* = male; with stamens of equal length)

L.C.J. Julaihi

Icon. Pl. 2 (1840) 359; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 165; Ridley, FMP 2 (1923) 260; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 108, *ibid.* 3, 8 (1927) 418; Masamune, EPB (1942) 589; Jeuken, Blumea 6 (1952) 554; Ng, TFM 1 (1972) 400; Anderson, CLTS (1980) 315; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 589; Pennington, Gen. Sapot. (1991) 153; Coode *et al.* (eds.), CLBD (1996) 305.

Trees. **Stipules** present, often small, caducous. **Leaves** *spirally arranged*, well-spaced along twigs or crowded at ends of twigs, without glandular pits in axils of lateral veins; lateral veins arching and joining into intramarginal veins or diminishing and becoming inconspicuous towards leaf margin; *intercostal venation densely oblique-scalariform* or *reticulate*. **Inflorescences** 2–many-flowered fascicles, axillary or in axils of leaf scars on older, leafless branchlets. **Flowers** bisexual, *subsessile*; *sepals 4*, *in two whorls of 2*, rarely 5 in two whorls of 2 and 3, outer sepals valvate, inner ones imbricate; corolla campanulate, *lobes 4*(*–5*), imbricate, rarely contorted, erect or slightly spreading, equal or exceeding the length of corolla tube, *corolla tube glabrous*

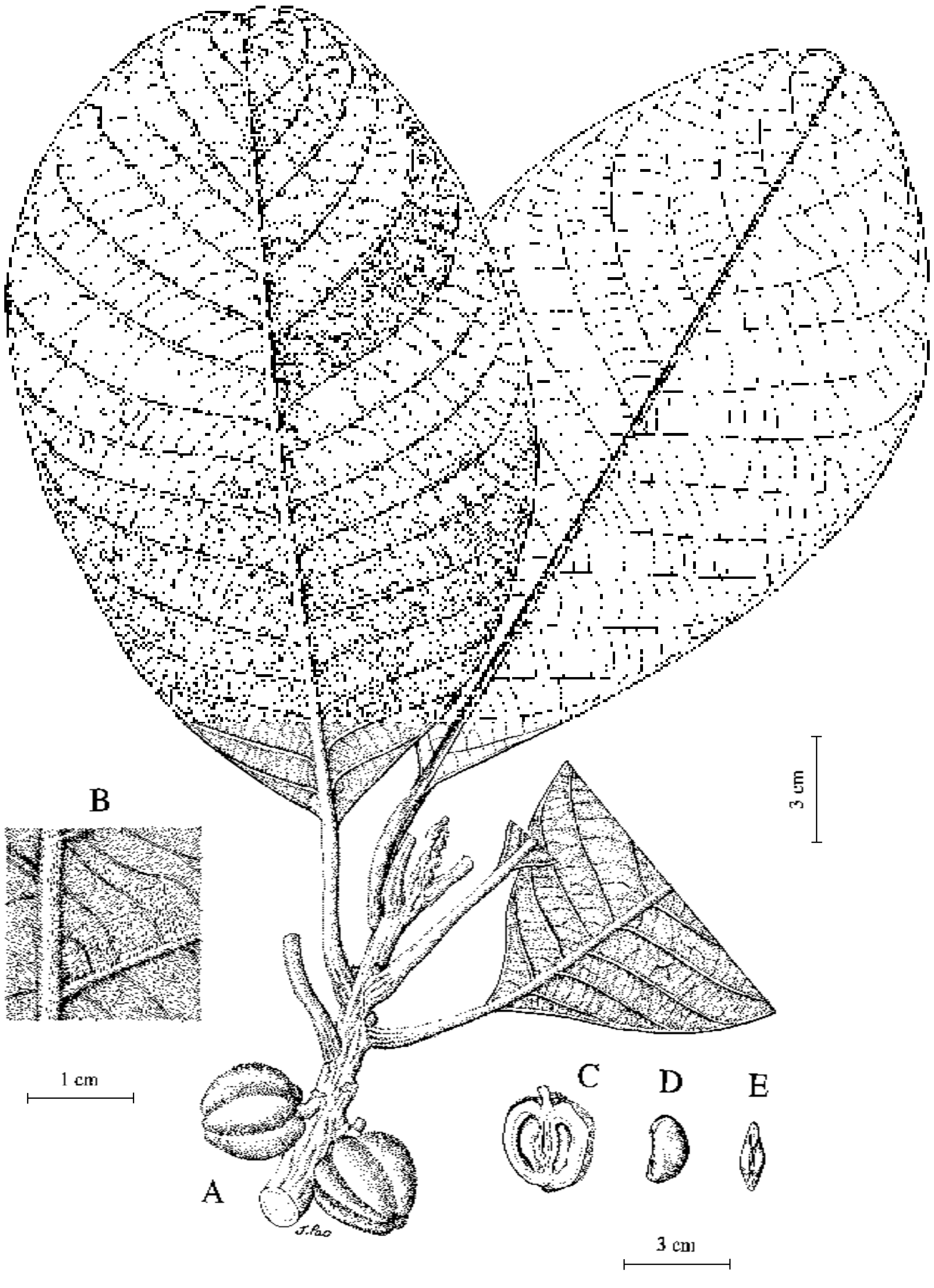

Fig. 4. *Eberhardtia aurata*. A, fruiting leafy twig; B, detailed venation of lower leaf surface; C, longitudinal section of fruit; D, seed in side view; E, seed in ventral view. (All from *FRI 41348*.)

at the throat; *stamens 8–10*, in a single whorl, inserted at top of corolla tube; filaments free or partially fused at base, anthers extrorse, usually hairy at tips; disk (nectary) absent; *ovary 4*(*–5*)-*loculed*, hairy, style slightly exserted. **Fruits** 1–2-seeded. **Seeds** ellipsoid, laterally compressed; scar long and narrow; cotyledons foliaceous; endosperm copious.

Distribution. Ten species, distributed in the southern part of India, Sri Lanka, Peninsular Malaysia and Borneo (2 species in Sarawak, Brunei and Kalimantan).

Taxonomy. *Isonandra* is intermediate between *Palaquium* and *Madhuca.* It differs from *Palaquium* and *Madhuca* by its flower with 4(–5)-lobed corolla, glabrous corolla tube, 8 stamens and 4(–5)-loculed ovary.

Key to *Isonandra* species

Leaves well-spaced along twigs, densely appressed tomentose beneath; coriaceous, elliptic to obovate; lateral veins diminishing near leaf margin. Inflorescences 2–3-flowered, axillary. Fruits fusiform………….......……………………………**1. I. borneensis**

Leaves densely clustered at end of twigs; glabrous or sparsely tomentose beneath; chartaceous to subcoriaceous, broadly ovate, oblong-lanceolate to obovate-lanceolate; lateral veins arching and joining into intramarginal veins. Inflorescences 2–10-flowered, axillary or in axils of leaf scars on older, leafless branchlets. Fruits oblong to ovoid-globose………..………………………………………………………**2. I. lanceolata**

1. **Isonandra borneensis** H.J.Lam Fig. 5.

(of Borneo)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 108, *l.c.* (1927) 418; Masamune *l.c.* 589; Jeuken *l.c.* 574. **Type:** *Amdjah* (*exp. Nieuwenhuis*) *162*, Borneo, Kalimantan, Bt. Mili (holotype BO).

Tree to 40 m tall, 70 cm diameter; buttresses steep, to 3.5 m tall and 3 m wide. **Bark** finely fissured and thinly flaky, dirty brown; inner bark soft, reddish brown. **Sapwood** yellow. **Twigs** slender and terete, sparsely pubescent. **Stipules** deltoid to lanceolate, rusty-brown hairy. **Leaves** *well-spaced along twigs*, *coriaceous*, glabrous above, *densely appressed tomentose beneath*; *elliptic* to *obovate*, 2.7–9.5 × 1.5–4.3 cm, base cuneate, apex shortly acute or retuse; midrib raised and prominent below; *lateral veins* 8–13 pairs, ascending at an angle of 50–55° from midrib, *diminishing near leaf margin*; intercostal venation slender, obliquely scalariform, distinct on both sides; petiole 0.3–1.8 cm long. **Inflorescences** *2–3-flowered*, *axillary*. **Flowers** white; pedicel 0.1–0.15 cm long; sepals 4(–5), ovate, rusty-brown hairy outside, glabrous within; corolla *c.* 2 mm long, glabrous, 4-lobed, lobes as long as corolla tube; stamen filaments *c.* 1 mm long, anther lanceolate; ovary 4-loculed. **Fruits** *fusiform*, *c.* 1.2 × 0.3 cm, densely appressed rusty-brown hairy. **Seeds** *c.* 0.5 × 0.1 cm.

Distribution. Endemic to Borneo. Known from Sarawak (e.g., *S 29286*), Brunei (e.g., *BRUN 149*) and Kalimantan.

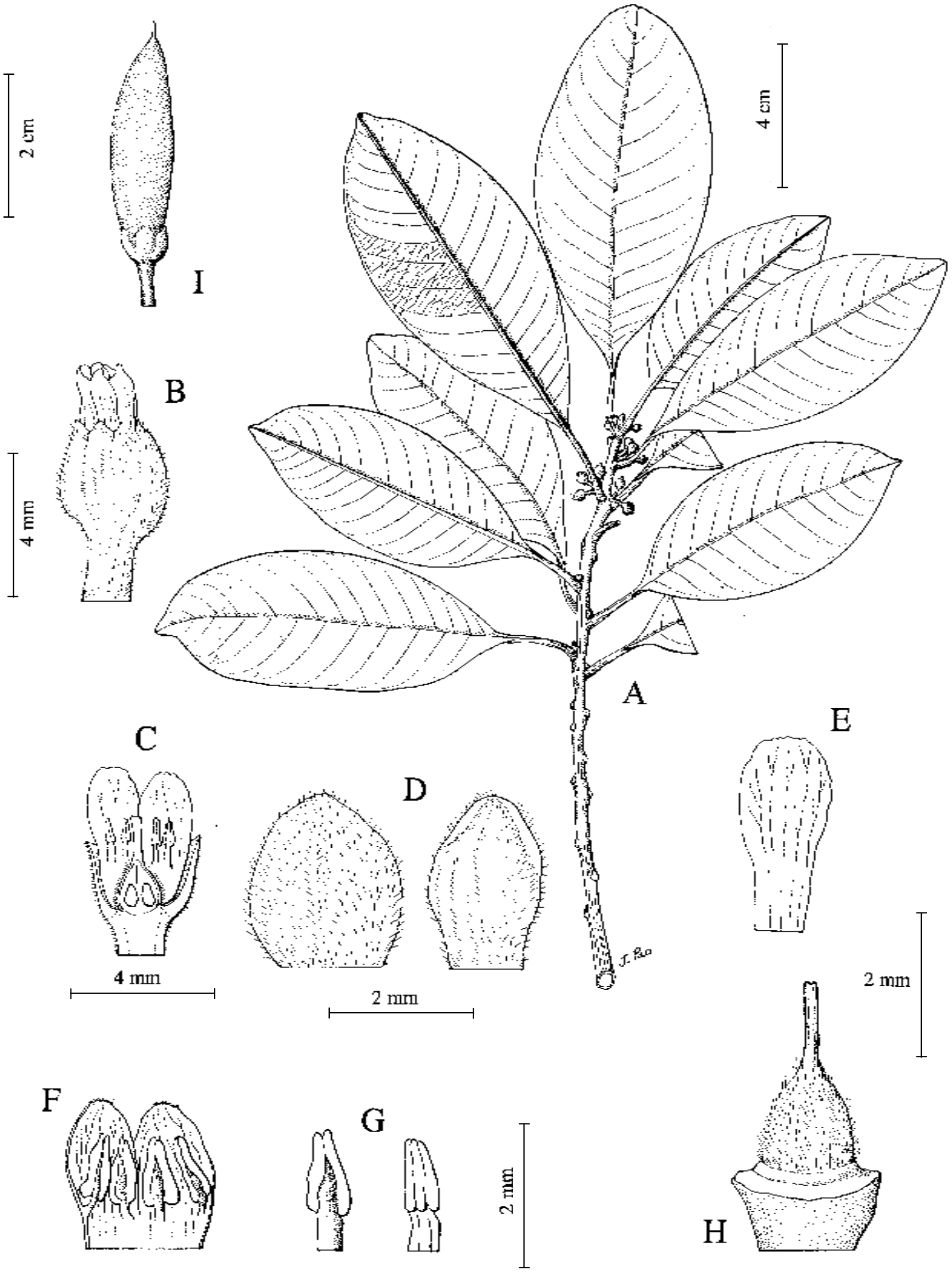

Fig. 5. *Isonandra borneensis.* A, flowering leafy twig; B, nearly open flower; C, longitudinal section of flower; D, outer and inner sepals; E, petal; F, inner side of petals showing the attachment of stamens; G, stamens in dorsal and ventral views; H, pistil; I, fruit. (All from *BRUN 149*.)

Ecology. In *kerangas* forest, at altitudes to 1000 m.

2. **Isonandra lanceolata** Wight

(Latin, *lanceolatus* = spear-shaped; the leaves)

Icon. Pl. 2 (1840) 359; H.J. Lam *l.c.* (1925) 110, *l.c.* (1927) 421; Jeuken *l.c.* 557; Anderson *l.c.* 315; Whitmore, Tantra & Sutisna *l.c.* 589; Pennington *l.c.* 154; Coode *et al.* (eds.) *l.c.* 305. **Lectotype** (Jeuken, 1952)**:** *Herb. Wight No. 1732*, India, Deccan, Courtallum (hololectotype K). **Synonyms:** *I. wightiana* A.DC., Prodr. 8 (1844) 187; *Bassia wightiana* (A.DC.) Beddome, For. Man. Bot. (1870) 141; *I. gracilis* H.J.Lam *l.c.* (1927) 418.

Tree to 26 m tall, 46 cm diameter. **Bark** scaly to flaky, chocolate brown. **Leaves** *densely clustered at ends of twigs*; *chartaceous* to *subcoriaceous*, glabrous above, *glabrous* or *sparsely tomentose beneath*; *broadly ovate*, *oblong-lanceolate* to *obovate-lanceolate*, 3–9 × 1.2–4.6 cm, base acute, attenuate to cuneate, apex acute, acuminate, obtuse or mucronate; midrib flat or crested above, raised and prominent below; *lateral veins* 5–14 pairs, ascending at an angle of *c.* 60° from midrib, *arching and joining into intramarginal veins*; intercostal venation slender, obliquely scalariform, obscure on both sides; petiole 0.5–2 cm long, grooved on adaxial side. **Inflorescences** *2–10-flowered*, *axillary* or *in axils of leaf scars on older*, *leafless branchlets*. **Flowers** pale yellow; pedicel 0.2–0.7 cm long; sepals 4–5, ovate to lanceolate, *c.* 2–3 × 2 mm, silky-brown tomentose outside, glabrous within; corolla 4–5-lobed, glabrous; filaments *c.* 2 mm long, anthers white, glabrous or sparsely hairy; ovary 4–5-loculed. **Fruits** *oblong* to *ovoid-globose*, 0.8–1.8 × 0.6–1 cm.

Distribution. Southern part of India, Sri Lanka and Borneo. In Sarawak occurs in lowland limestone hills at Bau and Niah NP (e.g., *S 34532*, *S 38646* and *S 40060*). In Brunei (e.g., *BRUN 742* and *BRUN 1668*), recorded from the summit of G. Pagon Periok.

Key to varieties

Leaves ovate to oblong-lanceolate, base acute; lateral veins 4–12 pairs. Inflorescences 6–10-flowered. Fruits oblong, 0.8–1.8 × 0.6–0.8 cm..

var. **lanceolata**

Leaves 2–23 × 1.5–10 cm, apex obtuse to acuminate, acumen 0.2–2 cm. Pedicels 0.2–0.5 cm long. Sepals *c.* 3 mm long; corolla 4–5-lobed; stamens 8–10; ovary 4–5-loculed.

In lowland to montane forest, at altitudes to 2000 m.

Leaves obovate-lanceolate; base attenuate to cuneate; lateral veins 12 pairs or more. Inflorescences 2–3-flowered. Fruits ovoid-globose, 0.8–1 cm across.................................

var. **gracilis** (H.J.Lam) Jeuken

(Latin, *gracilis* = slender)

l.c. 561. Basionym: *I. gracilis* H.J.Lam *l.c.* (1927) 418. Type: *Amdjah 985*, Borneo, Kalimantan, Samenggaris (BO).

Leaves 6–10 × 2–4.7 cm, apex acuminate with an obtuse point; lateral veins 12–13 pairs. Pedicels to 0.7 cm long. Sepals *c.* 2 mm long; corolla 4-lobed; stamens 8–9; ovary 4-loculed.

Endemic to Borneo. In lowland and hill mixed dipterocarp forests.

6. **MADHUCA** Buch.-Ham. *ex* J.F.Gmelin

(After an Indian plant name—*madhuka*)

P.C. Yii & P.P.K. Chai

Syst. Nat. 2, 1 (1791) 773 & 799; Merrill, Enum. Phil. Fl. Pl. 3, 3 (1923) 276, PEB (1929) 238; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 152, *ibid.* 3, 8 (1927) 443; Ridley, FMP 5 (1925) 319; Masamune, EPB (1942) 590; Browne, FTSB (1955) 320; P. Royen, Blumea 10 (1960) 2; Backer & Bakhuizen *f.*, FJ 2 (1965) 192; Burgess, TBS (1966) 447; Keng, OFMSP (1969) 225; Ng, TFM 1 (1972) 401; Anderson, CLTS (1980) 316; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 318; Pennington, Gen. Sapot. (1991) 154; PROSEA 5, 1 (1993) 283; Kessler & Sidiyasa, TBSA-EK (1994) 212; Turner, Gard. Bull. Sing. 47 (1995) 463; Coode *et al.* (eds.), CLBD (1996) 305; Argent *et al.* (eds.), MNDT-CK 2 (1997) 575. **Synonyms:** *Bassia auct. non* All.: J. König *ex* L., Mantissa 2 (1771) 555, *nom. illeg.*, Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 658, Hooker *f.*, Fl. Br. Ind. 3 (1882) 543, King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 176, Foxworthy, Philip. J. Sci. 4, (1909) 539, Merrill, Philip. J. Sci. Bot. 10 (1915) 56, EB (1921) 478, Ridley, FMP 2 (1923) 265; *Azaola* Blanco, Fl. Filip. ed. 1 (1837) 402; *Kakosmanthus* Hassk., Flora 38 (1855) 577, Merrill *l.c.* (1921) 478; *Illipe* J. König *ex* Gras, Bull. Soc. Bot. Fr. 11 (1864) 83 (substitute name for *Bassia* L. (1771), *non* All.), Foxworthy *l.c.* 539; *Ganua* Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 201, H.J. Lam *l.c.* (1925) 118, *l.c.* (1927) 424, Masamune *l.c.* 588, Van den Assem, Blumea 7 (1953) 369, Van den Assem & Kostermans, Blumea 7 (1954) 481, H.J. Lam, Blumea 8 (1957) 510, Ng *l.c.* 397, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 316.

Trees. **Stipules** present, sometimes large and persistent or absent. **Leaves** *spirally arranged* or very rarely alternate and distichous, well-spaced along twigs, or densely clustered on nodes, or crowded at ends of twigs, distinctly stalked, rarely subsessile; blade with plane, revolute or rarely erose (gnawed) margin; lateral veins diminishing and becoming inconspicuous towards leaf margin or arching and joining into intramarginal smooth veins or vein-loops; *intercostal venation subscalariform*, or *reticulate-tessellate*, or rarely descending from leaf margin and parallel to lateral veins, or a combination of these. **Inflorescences** *1–many-flowered fascicles* axillary or *in axils of leaf scars*. **Flowers** bisexual, *distinctly pedicellate*; *calyx of two whorls of 2 sepals*, occasionally of 5 sepals with 3 inner and 2 outer ones, outer sepals thick, usually valvate, inner sepals imbricate, thinner; *corolla* tubular, (*6–*)*8–12*(*–17*)*-lobed*, lobes imbricate, spreading or reflexed, each lobe not divided into segments, *corolla tube* shorter or about the same length with lobes, *barbate* or *hirsute at the throat*; *stamens* (*12–*)*14–36*(*–43*), in one, two or three whorls, inserted at throat of corolla tube, occasionally with the lowermost whorl attached near the base of corolla tube, filaments short or absent, anthers extrorse, lanceolate or sagittate, laterally or extrorsely dehiscent; nectary (disk) occasionally present; *ovary* (*4–*)*6–8*(*–15*)*-loculed*, glabrous or hairy, style long-tapering and exserted. **Fruits** 1(–4)-seeded; pericarp thin or thick, woody or fleshy. **Seeds** plano-convex or laterally compressed; scar adaxial, oblong or linear; cotyledons plano-convex, or thick and flat, or rarely foliaceous; endosperm scanty or absent.

Distribution. About 100 species; India, Myanmar, Thailand, Indo-China, S China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, and New Guinea. In Borneo, 50 species are known, of which 47 occur in Sabah and Sarawak.

Ecology. Common in primary forest from lowland to about 2500 m altitude.

Uses. *Madhuca* produces high quality *nyatoh* timber, well known for its fine texture and decorative grains. It is highly valued for panelling, flooring, solid doors, veneer and plywood. Except for

M. betis, it is not durable when used outdoors. Many species also produce 'gutta-percha'. In the Philippines, the fruits of *M. obovatifolia* are reported to be edible, having similar taste to that of *ciku* (*Manilkara zapota*). In Sarawak, fat extracted from seeds of *M. motleyana* is used for cooking. Seeds of a few other species are also reported to be edible. In India, nectar extracted from flowers of *M. motleyana* is used for sweetening food and fermenting liquors. The fat extracted from the seeds is used for making margarine, soap and candle wax.

Taxonomy. *Ganua*, first described by Dubard in 1908, had been recognised as a distinct genus by subsequent authors until 1991, when Pennington showed that *Madhuca* and *Ganua* could not be separated in both vegetative and floral characters and concluded that the two genera should be combined.

Key to *Madhuca* Species

1. Leaves well-spaced along twigs..2
Leaves in dense clusters of 4–10 on nodes, or crowded at ends of twigs, or spirally arranged and well-spaced along the apical part of twigs....................................26

2. Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops near or rather far from leaf margin...3
Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin........14

3. Leaf lateral veins arching and joining to form a smooth intramarginal vein near leaf margin..4
Leaf lateral veins arching and joining to form intramarginal vein-loops.....5

4. Leaves elliptic-lanceolate, 11–17 × 1.5–5 cm; lateral veins 15–23 pairs, ascending at an angle of *c.* 80° from midrib; intercostal venation descending from leaf margin and parallel to lateral veins...**32. M. palembanica**
Leaves narrowly obovate, 25–40 × 6.5–11 cm; lateral venation ascending at an angle of *c.* 65° from midrib; intercostal veins scalariform..........................**44. M. spectabilis**

5. Stipules absent..6
Stipules present...9

6. Twigs subangular. Leaves chartaceous; lateral veins ascending at an angle of 35–40° from midrib; intercostal venation scalariform...........................**6. M. costulata**
Twigs terete. Leaves subcoriaceous to thickly coriaceous; lateral veins ascending at an angle of 75–80° from midrib; intercostal venation descending from leaf margin and parallel to lateral veins..7

7. Twigs glabrous. Leaves subcoriaceous, glabrous on both surfaces. Corolla lobes lanceolate. Stamen filaments *c.* 2 mm long. Fruits ovoid, *c.* 1.2 × 0.9 cm. Seed scars *c.* 7 × 2 mm...**9. M. daemonica**
Twigs densely rusty-brown or greyish-brown tomentose. Leaves thickly coriaceous, densely rusty-brown tomentose or velvety hairy below. Corolla lobes spathulate or

obovate. Stamen filaments very short. Fruits subglobose, *c.* 2.5 × 1.5 cm. Seed scar 12–1 8 × 2–4 mm……………………………………………………………………………8

8. Twigs densely rusty-brown tomentose. Leaves elliptic to elliptic-obovate. Pedicel densely tomentose; sepals orbicular, *c.* 5–7 mm across; corolla lobes spathulate. Fruits densely rusty-brown tomentose………………………………………………**8. M. curtisii**
Twigs densely greyish-brown tomentose. Leaves ovate-elliptic. Pedical glabrous; sepals ovate, *c.* 4 mm long; corolla lobes obovate. Fruits glabrous…………**28. M. motleyana**

9. Leaves chartaceous; lateral veins ascending at an angle of 45–50° from midrib…………………………………………………………**25. M. mindanaensis**
Leaves coriaceous; lateral veins ascending at an angle of 60–85° from midrib...10

10. Stipules *c.* 1–4 × 2–4 mm. Leaf lateral veins 9–15 pairs; intercostal venation reticulate………………………………………………………………………11
Stipules 9–10 × 2–4 mm. Leaf lateral veins 20–50 pairs; intercostal venation scalariform……………………………………………………………………12

11. Twigs terete, glabrous. Stipules triangular, *c.* 1 × 0.4 mm. Leaves glabrous on both surfaces; lateral veins prominent on both sides. Petiole 2–3.5 cm long, flat or slightly raised on adaxial side. Stamens 16, filaments very short. Ovary subconical, hairy. Fruits ellipsoid, densely brownish-tomentose……………………………………………**13. M. engkikiana**
Twigs ridged, densely reddish-brown woolly hairy. Stipules lanceolate, *c.* 4 × 1 mm. Leaves reddish-brown hairy on midrib and lateral veins below; lateral veins impressed above, distinct below. Petiole 0.5–1 cm long, grooved on adaxial side. Stamens 12, filaments *c.* 1 mm long. Ovary discoid, glabrous. Fruits fusiform, glabrous……………………………………………………………………**37. M. rufa**

12. Twigs terete, rusty-brown velvety hairy at tips. Leaves glabrous on both surfaces; petiole 1.5–2.5 cm long. Sepals suborbicular, *c.* 10 × 14 mm; corolla *c.* 12 mm long; stamen filaments *c.* 5 mm long; ovary disciform………………………**24. M. markleeana**
Twigs subangular, densely rusty-brown tomentose all over. Leaves hairy at least on midrib and lateral veins below; petiole 2.5–7 cm long. Sepals triangular and 5–7 mm long or ovate-lanceolate and 6–9 × 3–5 mm; corolla 7–8 mm long; stamen filaments 0.5–3 mm long; ovary ovoid or subconical……………………………………………………………………13

13. Leaves densely golden-brown tomentose below, lanceolate or elliptic-oblong; lateral veins prominent on both sides; petiole broadly furrowed on adaxial side. Sepals triangular; stamens 22–28, filaments *c.* 0.5 mm long, anthers ovate-lanceolate, *c.* 2 mm long; ovary subconical, style clavate-subulate, 8–9 mm long……………**22. M. lancifolia**
Leaves sparsely hairy on midrib and lateral veins only, oblanceolate; lateral veins impressed above, prominent below; petiole flat on adaxial side. Sepals ovate-lanceolate; stamens 13–16, filaments *c.* 3 mm long, anthers narrowly sagittate, *c.* 4 mm long; ovary ovoid, style filiform, *c.* 3 mm long………………………………………………**39. M. sarawahensis**

14. Leaf intercostal venation reticulate……………………………………………15
Leaf intercostal venation scalariform or scalariform-tessellate…………………16

15. Twigs slender, terete. Stipules ovate-lanceolate, *c.* 2.5 × 1 mm. Leaves coriaceous, glabrous on both surfaces; lateral veins 6–11 pairs, ascending at an angle of 45–55° from midrib. Petiole 0.5–2 cm long, flat on adaxial side……………………………………**12. M. endertii**
Twigs stout, subangular. Stipules triangular, *c.* 4 × 4 mm. Leaves thickly coriaceous, silvery brown tomentose on both surfaces; lateral veins 15–19 pairs, ascending at an angle of 70–80° from midrib. Petiole 3–4 cm long, grooved on adaxial side…………… … ……………………………………………………………………**43. M. silamensis**

16. Twigs glabrous……………………………………………………………17
Twigs variously hairy………………………………………………………20

17. Stipules triangular, *c.* 4 × 2.5 mm. Leaf lateral veins ascending at an angle of 50–60° from midrib. Stamens 16–22; ovary disciform………………………………**4. M. burckiana**
Stipules ovate or lanceolate, 1.5–2 × 0.5–1 mm. Leaf lateral veins ascending at an angle of 40–50° from midrib. Stamens 12–18; ovary ovoid……………………………………18

18. Twigs terete. Leaf lateral veins 13–20 pairs. Ovary hairy……………**47. M. woodii**
Twigs subangular. Leaf lateral veins 6–13 pairs. Ovary glabrous…………………19

19. Stipules lanceolate. Leaf intercostal venation distinct on both sides. Petiole 1–3 cm long. Corolla lobes obovate-spathulate. Stamens 12……………**38. M. sandakanensis**
Stipules ovate. Leaf intercostal venation faint above, distinct below. Petiole 3–3.5 cm long. Corolla lobes oblong. Stamens 18……………………………**40. M. sepilokensis**

20. Twigs woolly pubescent. Stipules 7–12 × 3–7 mm……………**36. M. pubicalyx**
Twigs covered with persistent appressed yellowish-brown indumentum, sericeous or greyish or brownish velvety hairy. Stipules 2–5 × 1–2 mm or minute…………………21

21. Leaves glabrous on both surfaces…………………………………………………22
Leaves variously pubescent at least on lower surface…………………………23

22. Twigs slender. Leaf intercostal venation laxly scalariform. Petiole puberulous at base. Corolla *c.* 6 mm long, 8-lobed, lobes ovate. Stamens 18, anthers oblong-ovoid. Fruits ellipsoid……………………………………………………**20. M. korthalsii**
Twigs stout. Leaf intercostal venation scalariform-tessellate. Petiole glabrous. Corolla *c.* 12 mm long, 10–12-lobed, lobes elliptic-lanceolate. Stamens 22–25, anthers sagittate. Fruits oblong-obovoid……………………………………**23. M. malaccensis**

23. Twigs covered with persistent appressed yellowish-brown indumentum. Leaves chartaceous to subcoriaceous; lateral veins 5–9 pairs, ascending at an angle of 35–45° from midrib………………………………………………………**14. M. engleri**
Twigs greyish or brownish velvety hairy or greyish sericeous. Leaves coriaceous; lateral veins (8–)10–20 pairs, ascending at an angle of 60–80° from midrib……24

24. Twigs stout. Stipules *c.* 5 × 2 mm. Leaf lateral veins to 20 pairs, ascending at an angle of 65–80° from midrib…………………………………………**30. M. oblongifolia**
Twigs slender. Stipules *c.* 2.5 × 1 mm or minute. Leaf lateral veins to 14 pairs, ascending at an angle of *c.* 60° from midrib…………………………………………………25

25. Twigs brownish velvety hairy. Leaf apex obtuse; lateral veins obscure above, distinct below. Petiole 0.8–1 cm long. Inflorescences 1–3-flowered; anthers oblong, *c.* 0.6 mm long; ovary disciform……………………………………………**26. M. montana**
Twigs greyish sericeous. Leaf apex acuminate; lateral veins prominent on both sides. Petiole 1.3–4.5 cm long. Inflorescences 3–7-flowered; anthers sagittate, *c.* 2.5 mm long; ovary ovoid…………………………………………………**41. M. sericea**

26. Leaves in dense clusters of 4–10 on nodes…………………………………27
Leaves crowded at ends of twigs or spirally arranged and well-spaced along apical part of twigs……………………………………………………………………………28

27. Stipules absent. Leaves coriaceous, base attenuate; lateral veins diminishing and becoming inconspicuous toward leaf margin, ascending at an angle of 50–60° from midrib, obscure above, prominent beneath; intercostal venation descending from leaf margin and parallel to lateral veins………………………………**5. M. cheongiana**
Stipules present, subulate. Leaves chartaceous to subcoriaceous, base cuneate or abruptly truncate or subcordate and slightly oblique; lateral veins arching and joining to form intramarginal vein-loops, ascending at an angle of 70–85° from midrib, prominent on both sides; intercostal venation distinctly reticulate…………………**33. M. pallida**

28. Leaves variously hairy at least on lower surface…………………………………29
Leaves glabrous on both surfaces or covered with remnants of scattered silvery hairs especially on midrib below……………………………………………………34

29. Leaves rusty-brown tomentose on both surfaces………………**15. M. erythrophylla**
Leaves glabrous above, variously hairy below……………………………………30

30. Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin...31
Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops along leaf margin……………………………………………………………32

31. Twigs rusty-brown hairy, terete. Stipules triangular, *c.* 1 × 0.5 mm. Leaf margin plane; intercostal venation reticulate or reticulate-tessellate near leaf margin...**10. M. dubardii**
Twigs glabrous, angular. Stipules broadly ovate, *c.* 5 × 4 mm. Leaf margin recurved; intercostal venation descending from leaf margin and parallel to lateral veins…………… ………………………………………………………………………**31. M. ochracea**

32. Stipules 5–7 × 1 mm. Leaves smaller, 11–15 × 4.5–6 cm; intercostal venation descending from leaf margin and parallel to lateral veins……………**16. M. fusca**
Stipules 7–18 × 1.5–8 mm. Leaves larger, 15–40 × 6–18 cm; intercostal venation scalariform……………………………………………… ………… . ….33

33. Leaves subcoriaceous; petiole 1.6–2.5 cm long. Twigs angularly ridged. Stipules ovate-acuminate to linear-lanceolate……………………………………**2. M. borneensis**
Leaves coriaceous; petiole 2.5–4 cm long. Twigs with rounded ribs. Stipules ovate-lanceolate or triangular-lanceolate………………………**34. M. primoplagensis**

34. Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin…… ……………………………………………………………………………… . 35

Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops near or rather far from leaf margin……………………………………………………36

35. Stipules broadly ovate, *c.* 1 × 0.5 mm. Leaves coriaceous, waxy above; intercostal venation laxly scalariform……………………………………………**17. M. glabrescens**
Stipules linear, *c.* 3 × 1 mm. Leaves membranaceous to chartaceous, not waxy above; intercostal venation reticulate……………………………………………**45. M. utilis**

36. Leaf lateral veins arching and joining into a smooth intramarginal vein…………37
Leaf lateral veins arching and joining to form vein-loops near or rather far from leaf margin……………………………………………………………………39

37. Stipules 5–10 × 4–8 mm. Leaves coriaceous; intercostal venation densely scalariform……………………………………………………………………**19. M. kingiana**
Stipules *c.* 2 mm long, or absent. Leaves subcoriaceous; intercostal venation descending from leaf margin and parallel to lateral veins……………………………38

38. Twigs sparsely hairy. Terminal buds *c.* 3 mm long. Stipules absent. Leaves oblanceolate or obovate, drying pale yellowish brown; intercostal venation obscure above, distinct below. Pedicel 2.8–3.5 cm long………………………………**1. M. barbata**
Twigs glabrous. Terminal buds *c.* 5 mm long. Stipules present, *c.* 2 mm long. Leaves oblong or oblong-lanceolate, drying reddish brown; intercostal venation obscure on both sides. Pedicel 1.5–2.5 cm long……………………………………**27. M. monticola**

39. Leaf intercostal venation descending from leaf margin and parallel to lateral veins……………………………………………………………………**3. M. brochidodroma**
Leaf intercostal venation scalariform, reticulate or reticulate-tessellate…………..40

40. Leaf intercostal venation scalariform……………………………………………41
Leaf intercostal venation reticulate or reticulate-tessellate………………………42

41. Twigs densely woolly-tomentose. Stipules shield-shaped, *c.* 6 × 2 mm. Leaf lateral veins 18–26 pairs. Sepals ovate, 6–7 × 4–5 mm. Fruit pericarp fleshy. Seeds pointed at both ends……………………………………………………………**11. M. elmeri**
Twigs rusty-brown velvety hairy at apex only. Stipules broadly ovate, *c.* 6 × 4 mm. Leaf lateral veins 28–45 pairs. Sepals orbicular, *c.* 6 mm across. Fruit pericarp thin. Seeds obtuse at both ends……………………………………………**29. M. multinervia**

42. Twigs glabrous. Stipules absent. Leaf intercostal venation laxly reticulate. Petiole very short, leaves almost sessile……………………………………………**42. M. sessilis**
Twigs hairy, at least on nodes. Stipules present. Leaf intercostal venation laxly to densely reticulate or reticulate-tessellate. Petiole (1.5–)2–5(–8) cm long……………43

43. Twigs densely woolly-brown or greyish tomentose. Terminal buds 7–15 mm long. Stipules 3–12 × 1–5 mm……………………………………………………………44
Twigs rusty-brown velvety-hairy. Terminal buds 2–3 mm long. Stipules 2–3 × 1–1.5 mm……………………………………………………………………………46

44. Twigs ridged or angular, densely woolly-tomentose on nodes only. Terminal buds 12–15 mm long. Stipules lanceolate, *c.* 12 × 5 mm. Leaves broadly obovate; margin erose (gnawed); lateral veins 19–25 pairs. Sepals oblanceolate. Fruits ellipsoid………………………………………………………………………………**18. M. hirtiflora**
Twigs terete, densely woolly-brown tomentose or greyish tomentose all over. Terminal buds 7–10 mm long. Stipules linear or narrowly triangular, 3–4 × 1–2 mm. Leaves spathulate, obovate, or narrowly obovate; margin entire and plane or slightly recurved; lateral veins 10–20 pairs. Sepals lanceolate or oblong-ovate. Fruits ovoid-ellipsoid or subglobose…………………………………………………………………45

45. Stipules linear. Leaves spathulate or obovate, 5–10 × 2.5–4 cm; margin slightly recurved; lateral veins 10–12 pairs, ascending at an angle of *c.* 60° from midrib. Sepals lanceolate; corolla 8–9-lobed; stamens 17–19. Fruits obovoid-ellipsoid, 4–5.5 × 2–3.3 cm; pericarp thick and fleshy, granular…………………………………**7. M. crassipes**
Stipules narrowly triangular. Leaves narrowly obovate, 16–24 × 6–9 cm; margin plane; lateral veins 15–20 pairs, ascending at an angle of 80–85° from midrib. Sepals oblong-ovate; corolla 12-lobed; stamens 24. Fruits subglobose, *c.* 2 × 1.7 cm; pericarp thin, smooth……………………………………………………………**35. M. prolixa**

46. Leaves elliptic to oblong-elliptic; lateral veins 11–13 pairs. Inflorescences 5–8-flowered; corolla 8-lobed; stamens 16 in two whorls…………**21. M. kuchingensis**
Leaves oblanceolate, obovate or obovate-elliptic; lateral veins (9–)15–20 pairs. Inflorescences 1–3(rarely to 8)-flowered; corolla 8–16-lobed; stamens 16–32 in two or three whorls…………………………………………………**46. M. vulpina**

1. **Madhuca barbata** T.D.Penn.

(Latin, *barbatus* = bearded with tufted, long soft hairs; the sepals)

Gen. Sapot. (1991) 156. **Type:** *Haviland & Hose 3482A*, Borneo, Sarawak, Kuching (holotype L). **Synonym:** *Ganua pierrei auct. non* (Williams) H.J.Lam: Van den Assem *l.c.* 392, Anderson *l.c.* 315.

Small tree. **Twigs** subangular, *sparsely hairy*. **Terminal buds** *c. 3 mm long*, with distinct caducous bud-scales. **Stipules** *absent*. **Leaves** *crowded at end of twigs*, *subcoriaceous*, *glabrous on both surfaces*, *drying pale yellowish brown*; *oblanceolate* or *obovate*, 10–16 × 4–6.5 cm, base narrowly cuneate, margin entire and plane, apex obtuse or acuminate with a blunt tip; midrib flat or slightly raised above, prominent beneath; *lateral veins* slender, 12–17 pairs, ascending at an angle of 70–80° from midrib, *arching and joining into a smooth intramarginal vein*, obscure above, distinct below; *intercostal venation* slender, *descending from leaf margin and parallel to lateral veins*, laxly reticulate near leaf margin, *obscure above*, *distinct below*; petiole 2–2.8 cm long, broadly grooved on adaxial side, thickened and black at base. **Inflorescences** in axils of leaf scars below leafy parts of twigs, 6–12-flowered. **Flowers:** *pedicel 2.8–3.5 cm long*, sepals ovate or deltoid, 5 × 3–5 mm, apex set with tufted, long, soft, dark hairs; corolla 2–3 mm long, lobes 8–12, ribbon-like; stamens 16–24, filaments *c.* 15 mm long, anthers with short acumen; ovary glabrous, 8–12-loculed. **Fruits** unknown.

Vernacular name. Sarawak—*ketiau putih* (Malay).

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 203*, *S 521*, *S 528*, *S 534*, *S 2683*, *S 2690*, *S 9737*, *S 30154*, and *S 30164*).

Ecology. Uncommon in peat swamp forest, occasionally also found in lowland mixed dipterocarp forest.

2. **Madhuca borneensis** P.Royen

(of Borneo)

Blumea 10 (1960) 20; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 318; Vink, Blumea 46 (2001) 193. **Type:** *Jaheri s.n.* (*exp. Nieuwenhuis*), Borneo, Kalimantan (holotype L; isotype BO). **Synonym:** *M. eriobrachyon* P.Royen *l.c.* (1960) 40.

Tree to 30 m tall, 50 cm diameter. **Bark** greyish with dark-grey mottles; inner bark dull orange. **Twigs** slender, *angularly ridged*, densely covered with persistent yellowish-brown woolly tomentum. **Terminal buds** to 12 mm long. **Stipules** *ovate-acuminate* to *linear-lanceolate*, *c. 7–18 × 1.5–4.5 mm*, densely woolly tomentose outside. **Leaves** *crowded at ends of twigs* or *spirally arranged and well-spaced along ends of twigs*, *subcoriaceous*, except for midrib *glabrous above*, *densely woolly-tomentose below*; *oblanceolate* or *obovate*, *15–40 × 6–13 cm*, base cuneate, acute to subrotundate and slightly oblique, margin plane, apex acuminate with a sharp tip; midrib grooved and narrowly crested above, prominent below; *lateral veins* 16–22 pairs, ascending at an angle of *c.* 60° from midrib, *arching and joining into a smooth intramarginal vein*, impressed above, prominent below; *intercostal venation* slender, *laxly scalariform*, *distinct above*, *prominent below*; *petiole 1.6–2.5 cm long*, narrowly grooved on adaxial side, thickened and rugose at base, densely woolly-tomentose. **Inflorescences** in axils of leaf scars, 4–7-flowered. **Flowers:** pedicel angular, 2–3 cm long, densely woolly-tomentose; sepals oblong-ovate, 5–6.5 × 4–6 mm, yellowish-brown tomentose; corolla bell-shaped, white, 6–8 mm long, lobes 8, lanceolate to elliptic; stamens 16–20, filaments 1.5–3 mm long, anthers *c.* 2 mm long, oblong-ovate, villous; ovary ovoid to depressed globose, villous, style glabrous. **Fruits** ovoid to ellipsoid, 2–2.8 × 1–1.7 cm, 1-seeded; pericarp fleshy, densely reddish-brown woolly-tomentose. **Seeds** laterally compressed, ellipsoid to obovoid, 1.8–2.3 × 0.7–1.2 cm, obtuse at both ends; testa thin, pale brown, smooth; scar *c.* 17 × 5 mm.

Vernacular name. Sarawak—*nyatoh bulu merah* (Malay).

Distribution. Endemic to Borneo. Known from C Sarawak (e.g., *S 15120*, *S 23226*, *S 26058*, *S 29065*, *S 29691*, *S 31929*, and *S 43611*) and western part of Kalimantan (e.g., *Hotta K-577*, *Jacobs 5380*, *Jaheri s.n.*, and *Kostermans 21166*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

3. **Madhuca brochidodroma** T.D.Penn.

(Greek, *brochidodroma* = loop-veined; the leaves)

Gen. Sapot. (1991) 157; Coode *et al.* (eds.) *l.c.* 305. **Type:** *Beccari PB 3085*, Borneo, Sarawak (holotype FI; isotype P). **Synonym:** *Ganua coriacea* Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 408, H.J. Lam *l.c.* (1925) 121, *l.c.* (1927) 424, *l.c.* (1957) 510, Masamune *l.c.* 588, Van den Assem *l.c.* 389, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317.

Tree to 25 m tall, 30 cm diameter, with numerous pointed pneumatophores. **Bark** brown, relatively smooth; inner bark dull orange, soft and fibrous. **Twigs** slender, terete, glabrous. **Terminal buds** glabrous, *c.* 2 mm long. **Stipules** absent. **Leaves** *crowded at ends of twigs*, thickly coriaceous, *glabrous on both surfaces*, drying dark blackish above, brownish black below; obovate to obovate-elliptic, 4–7 × 2–3 cm, base attenuate, margin plane, apex rounded or retuse; midrib raised and prominent on both sides; *lateral veins* slender, 9–13 pairs, ascending at an angle of 80–85° from midrib, *arching and joining into vein-loops near leaf margin*, obscure on both sides; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate-tessellate near leaf margin, obscure on both sides; petiole 0.7–1.2 cm long, terete, thickened at base, dark brown. **Inflorescences** axillary or in axils of leaf scars, 2–6-flowered. **Flowers:** pedicel *c.* 0.5 cm long; sepals deltoid, *c.* 2.5 × 2 mm, apex acute, silvery tomentose; corolla cream, *c.* 4 mm long, lobes 8, round; stamens 16, filaments very short, anthers ovate; ovary ovoid, glabrous, 8-loculed, style glabrous. **Fruits** ovoid, *c.* 2.1 × 1.2 cm, 1-seeded, acute at apex and round at base; pericarp thin, glabrous. **Seeds** laterally compressed, ellipsoid, 1.2 × 0.3–0.6 cm, pointed at both ends; testa thin, pale brown, smooth; scar linear, *c.* 14 × 2 mm.

Vernacular names. Sarawak—*ketiau merah* (Malay), *nyatoh cabi* (Melanau-Oya).

Distribution. Sumatra and Borneo. Uncommon and scattered throughout Sarawak (e.g., *S 406*, *S 545*, *S 875*, *S 1454*, *S 2714*, *S 5005*, and *S 30158*). Also known from Brunei (e.g., *SAN 17432*).

Ecology. In the inner zone of peat swamp forest.

Uses. Pole-sized trees are used as construction poles and for rafting logs.

4. **Madhuca burckiana** (Koord.) H.J.Lam

(W. Burck, 1848–1927, a Dutch botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 172, *l.c.* (1927) 453; P. Royen *l.c.* (1960) 68; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 319; Pennington *l.c.* 156. **Basionym:** *Illipe burckiana* Koord., Med.'s Lands Pl. Buitenz. 19 (1898) 518 & 640. **Type:** *Koorders 18883ß*, Sulawesi, Minahasa, Menado (holotype BO; isotype L). **Synonyms:** *Illipe burckiana* ("*burckeana*") (Koord.) Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 406 *in errore pro* "*Bassia burckiana* Koord."; *Payena fusicarpa* Elmer, Leafl. Philip. Bot. 8 (1915) 2820; *Bassia cagayanensis* Merr., Philip. J. Sci. Bot. 13 (1918) 48; *Madhuca fusicarpa* (Elmer) Merr. *l.c.* (1923) 276; *Illipe schlechteri* Krause, Bot. Jabrh. 58 (1923) 467.

Tree to 15 m tall, 20 cm diameter. **Bark** greyish brown, smooth; inner bark dull orange. **Twigs** terete or subangular, *glabrous*. **Terminal buds** glabrous, *c.* 4 mm long. **Stipules** *triangular*, *c. 4 × 2.5 mm*, crested. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous on both sides; elliptic or elliptic-obovate, 9–29 × 4–9 cm, base cuneate or subrotundate, margin plane, apex short-acuminate; midrib grooved and finely crested above, prominent below; *lateral veins* 9–17 pairs, *ascending at an angle of 50–60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, apical pairs arching and joining to form vein-loops, obscure above, prominent below; *intercostal venation scalariform*, obscure above, distinct below; petiole 1.2–4.5 cm long, flat to shallowly grooved on adaxial side, thickened at base. **Inflorescences** axillary, 3–10-flowered. **Flowers:** pedicel angular, 1.5–2 cm long; sepals broadly ovate, *c.* 5 × 4 mm, apex acute; corolla *c.* 7 mm long, lobes 8, oblong, rounded at apex; *stamens 16–22*, in two whorls, filaments subulate, anthers oblong-ovoid; *ovary disciform*, glabrous, 8–9-loculed, style filiform. **Fruits** ovoid-fusiform, 1.8–2.4 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, sparsely hairy, glabrescent. **Seeds** ellipsoid, *c.* 1.5 × 0.6 cm; testa thin, shining; scar linear.

Distribution. Borneo, the Philippines, Sulawesi, Maluku and Papua New Guinea. Scattered throughout Sabah (e.g., *SAN 17432*, *SAN 41325*, *SAN 65483*, *SAN 73689*, *SAN 74011*, and *SAN 121254*) and Sarawak (e.g., *S 36847*, *S 40782* and *S 43828*). Also occurs in Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forest, at altitudes to 1000 m.

5. **Madhuca cheongiana** Yii & P.Chai

(Cheong Ek Choon, Director of the Sarawak Forestry Department)

Gard. Bull. Sing. 53 (2001) 343. **Type:** *Beccari PB 3105*, Borneo, Sarawak, Kuching (holotype FI, *n.v.*). **Synonyms:** *Ganua sarawahensis* Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 409, H.J. Lam *l.c.* (1925) 130 ("*sarawakensis*"), *l.c.* (1927) 429 ("*sarawakensis*"), Van den Assem *l.c.* 375 ("*sarawakensis*"); *G. attenuata* Griffioen & H.J. Lam, *nom. ined.*, Anderson *l.c.* 314, *nom. nud.*

Tree to 30 m tall, 50 cm diameter. **Bark** pale brown or brown with greyish mottles, smooth to papery scaly; inner bark dull orange, soft and fibrous. **Twigs** subangular, pale greyish brown, glabrous. **Terminal buds** *c.* 10 × 3 mm, rusty hairy, with conspicuous narrowly triangular bud-scales. **Stipules** *absent*. **Leaves** *in dense clusters of 6–10 on nodes*, *coriaceous*, glabrous on both sides; obovate to elliptic-obovate, 11–25 × 3–6 cm, *base attenuate*, decurrent, margin plane, apex short-acuminate; midrib grooved above, round beneath; *lateral veins* 10–16 pairs, *ascending at an angle of 50–60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, *obscure above*, *prominent beneath*; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate near leaf margin, slender, obscure above, prominent beneath; petiole stout, 0.6–1.6 cm long, glabrous, thickened and rugose at base, upper parts broadly furrowed on adaxial side. **Inflorescences** in axils of lower leaves or leaf scars, 5–10-flowered. **Flowers:** pedicel 1.5–3.5 cm long, glabrous; sepals ovate-elliptic, *c.* 6 × 4 mm, apex obtuse or acuminate; corolla white, *c.* 11 mm long, lobes 8, lanceolate; stamens 16, filaments short, anthers lanceolate, villous; ovary subconical, 7–8-loculed, sparsely villous, style glabrous. **Fruits** unknown.

Vernacular name. Sarawak—*nyatoh daun mata lembing* (Malay).

Distribution. Endemic to Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN 33601*, *SAN 36601* and *SAN 126691*) and Sarawak (e.g., *S 2162*, *S 2222*, *S 15437*, *S 29477*, and *S 32947*). Also known from Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp and *kerangas* forests, at altitudes below 200 m.

6. **Madhuca costulata** (Pierre *ex* Dubard) H.J.Lam

(Latin, *costulatus* = finely ribbed; the distinctly veined leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 181, *l.c.* (1927) 462; Masamune *l.c.* 462; P. Royen *l.c.* (1960) 18; Whitmore, Tantra & Sutisna *l.c.* 319. **Basionym:** *Kakosmanthus costulatus* Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 198, Merrill *l.c.* (1921) 478. **Type:** *Beccari PB 3000*, Borneo, Sarawak, Matang (holotype P; isotype L).

Tree to 8 m tall, 10 cm diameter. **Bark** greyish; inner bark pale orange. **Twigs** slender, *subangular*, rusty-brown tomentose, glabrescent. **Terminal buds** *c.* 2 mm long, rusty-brown tomentose. **Stipules** *absent*. **Leaves** *well-spaced along twigs*; *chartaceous*, glabrous on both surfaces except for the finely silky-hairy midrib and lateral veins; elliptic to elliptic-obovate, 10–17 × 2.5–5 cm, base cuneate, margin plane, apex acuminate, acumen to 1.5 cm long, sharp-pointed; midrib narrowly raised above, round and prominent below; *lateral veins* 8–14 pairs, *ascending at an angle of 35–40° from midrib*, *arching and joining into intramarginal vein-loops rather far from leaf margin*, impressed above, prominent below; *intercostal venation* fine, *scalariform*, obscure on both sides; petiole slender, glabrous, 1.5–2.1 cm long, shallowly grooved and narrowly crested on adaxial side. **Inflorescences** axillary or in axils of leaf scars, 5–6-flowered. **Flowers:** pedicel 0.7–1.4 cm long, sparsely tomentose; sepals broadly ovate, 3.5–5 × 4–4.5 mm, apex subobtuse; corolla *c.* 5 mm long, lobes 7–9, lanceolate, apex obtuse; stamens 14, filaments subulate, anthers oblong; ovary ovoid, glabrous, style glabrous. **Fruits** laterally compressed, ellipsoid, 2–2.5 × 0.8–1.3 cm, 1-seeded, drying not black; pericarp fleshy and glabrous. **Seeds** ellipsoid, 1.5–2.2 × 0.5–1 cm, apex obtuse, base cuneate; testa thin, scar linear.

Vernacular name. Sarawak—*nyatoh semukau* (Iban).

Distribution. Endemic to Borneo and confined to the western part of Sarawak (e.g., *S 40754* and *S 41024*).

Ecology. Usually found along ridges and upper slopes of hill mixed dipterocarp forest below 300 m altitude.

7. **Madhuca crassipes** (Pierre *ex* Becc.) H.J.Lam Fig. 6.

(Latin, *crassus* = thick, *pes* = foot or stalk; the thick fruit stalk)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180, *l.c.* (1927) 462; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 101; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 319; Argent *et al.* (eds.) *l.c.* 576. **Basionym:** *Bassia crassipes* Pierre *ex* Becc., Nelle For. Born. ed. 1 (1902) 580, Merrill *l.c.* (1921) 478. **Type:** *Beccari PB 904*, Borneo, Sarawak, Kuching (holotype FI; isotypes L, P). **Synonym:** *Illipe crassipes* (Pierre *ex* Becc.) Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 405; *Croixia crassipes* (Pierre *ex* Becc.) Baehni, Boissiera 11 (1965) 109.

Tree to 40 m tall, 70 cm diameter, with steep plank buttresses to 2.5 m high, 1.2 m wide. **Bark** brown with greyish mottles, shallowly fissured; inner bark dull orange, soft and laminated. **Twigs** *terete*, *densely woolly-brown tomentose*. **Terminal buds** *c. 7 mm long*, densely woolly-brown tomentose. **Stipules** *linear*, *c. 4 × 1 mm*, woolly tomentose, caducous. **Leaves** *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*, glaucous below; *spathulate* or *obovate*, *5–10 × 2.5–4 cm*, base narrowly cuneate and slightly decurrent, *margin slightly recurved*, apex

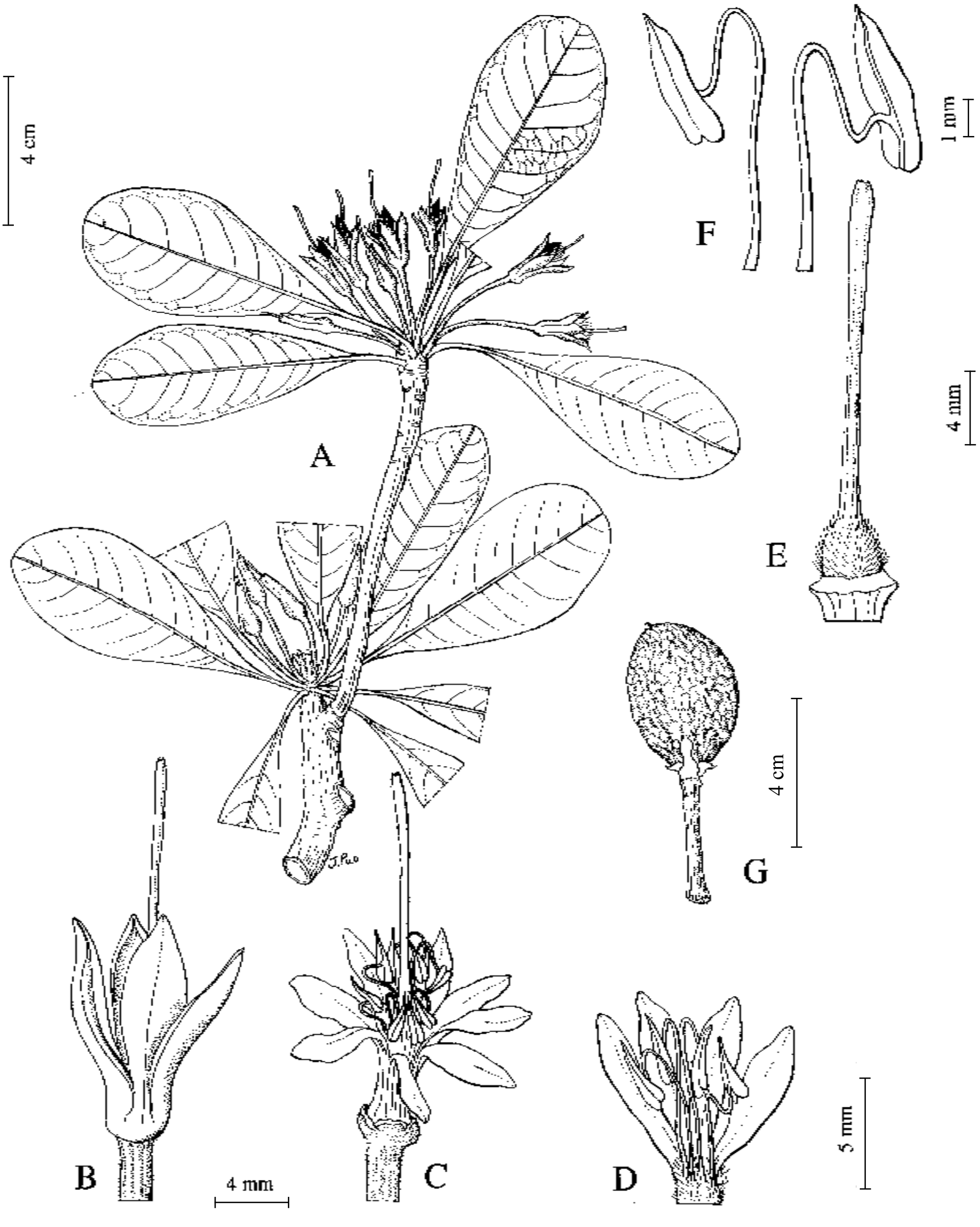

Fig. 6. *Madhuca crassipes*. A, flowering leafy twig; B, flower with petals and stamens removed to show sepals and style; C, flower with sepals removed; D, petals and stamens; E, pistil; F, stamens in different views; G, fruit. (A–F from *S 16657*, G from *S 32197*.)

rounded or retuse, rarely acuminate with an obtuse tip; midrib raised and prominent on both sides; *lateral veins 10–12 pairs*, *ascending at an angle of c. 60° from midrib*, *arching and joining to form vein-loops by thickened intercostal veins*, obscure above, distinct below; *intercostal venation* slender, *reticulate-tessellate*, occasionally intercepted by transverse veins, obscure above, distinct below; *petiole slender*, *1.5–2 cm long*, flat on adaxial side, round on abaxial side, sparsely pubescent by long brown silky-hairs. **Inflorescences** crowded in axils of leaves at ends of twigs, 5–10-flowered. **Flowers:** fragrant; pedicel angular, 0.7–2 cm long, to 3.5 cm long in fruit, woolly tomentose; *sepals lanceolate*, 9–11 × 2.5–3 mm, obtuse, densely woolly tomentose; corolla cream, 12–14 mm long, *lobes 8–9*, lanceolate, narrowly obtuse at apex; *stamens 17–19*, filaments filiform, anthers oblong, villous; ovary ovoid, glabrous, 8–9-loculed, style glabrous. **Fruits** oblique and laterally compressed, *obovoid-ellipsoid*, *4–5.5 × 2–3.3 cm*, 1-seeded, tapering at both ends; *pericarp thick and fleshy*, *granular*; stalk stout, 3–3.5 cm long, glabrous. **Seeds** laterally compressed, ellipsoid; testa thin, smooth and reddish brown; scar narrowly linear.

Vernacular name. Sarawak—*nyatoh jelutong* (Malay).

Distribution. Sumatra and Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN 49629*, *SAN 50999*, and *SAN 78097*) and Sarawak (e.g., *S 10684*, *S 16657*, *S 23757*, *S 30604*, and *S 32197*). Also occurs in Brunei and Kalimantan.

Ecology. In seasonal fresh water swamp, lowland mixed dipterocarp and lower montane forests, at altitudes to 1000 m.

8. **Madhuca curtisii** (King & Gamble) Ridl.

(Charles Curtis, 1852–1928, sometime superintendent of the Penang Botanic Garden, Malaysia)

FMP 5 (1925) 319; Pennington *l.c.* 157; Turner *l.c.* 463; Coode *et al.* (eds.) *l.c.* 306. **Basionym:** *Bassia curtisii* King & Gamble *l.c.* 181. **Type:** *Curtis 1451*, Peninsular Malaysia, Penang, Government Hill (holotype SING; isotype L). **Synonyms:** *Ganua chrysocarpa* Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 407, H.J. Lam *l.c.* (1925) 130, *l.c.* (1927) 429, P. Royen *l.c.* (1960) 111; *G. curtisii* (King & Gamble) H.J.Lam *l.c.* (1925) 126, *l.c.* (1927) 425, Van den Assem *l.c.* 388, Ng *l.c.* 397, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317; *Isonandra curtisii* (King & Gamble) Baehni *l.c.* 84; *Bassia perakensis* King & Gamble *l.c.* 183; *Madhuca perakensis* (King & Gamble) Ridl. *l.c.* (1925) 319; *M. chrysocarpa* (Pierre *ex* Dubard) Ridl. *l.c.* (1925) 342.

Tree to 28 m tall, 50 cm diameter, with low buttresses. **Bark** coarse, shedding off into small irregular flakes, exposing verrucose lenticellate reddish brown surface; inner bark dull orange, soft with conspicuous white latex. **Twigs** stout, *terete*, strongly marked with leaf scars and inflorescence warts, *densely rusty-brown tomentose*, glabrescent. **Terminal buds** *c.* 2.5 mm long, rusty-brown tomentose. **Stipules** *absent*. **Leaves** *well-spaced along twigs*, *thickly coriaceous*, glabrous above, *densely rusty-brown tomentose below*; *elliptic* to *elliptic-obovate*, 8–14 × 5.5–7 cm, base cuneate, margin plane, apex acuminate with an obtuse tip, or rounded or retuse; midrib raised on both sides, stronger below; *lateral veins* 11–17 pairs, *ascending at an angle of 75–80° from midrib*, *arching and joining to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate-tessellate near leaf margin, obscure above, prominent below; petiole slender, 1.5–2.5 cm long, terete, slightly thickened and curved at base. **Inflorescences** axillary or in axils of leaf scars, 3–12-flowered. **Flower:** sweet scented; *pedicel* angular, *c.* 1 cm long, to 0.5 cm thick in fruit, *densely tomentose*; *sepals orbicular*, *5–7 mm across*, rusty-brown tomentose; *corolla* greenish cream, thick and fleshy, *c.* 8 mm long, *lobes* 8–10, *spathulate*, apex obtuse; stamens 16–20, *filaments short* and villous, anthers ovate-acute, extrorse; ovary ovoid, villous, 8-loculed, style glabrous. **Fruits** *subglobose*, *c. 2.5 × 1.5 cm*, 1-seeded, *densely rusty-brown tomentose*. **Seeds** laterally compressed, ellipsoid, 1.2 × 0.6–1 cm; testa thin, smooth; *scar* narrowly linear, *c. 12 × 2 mm*.

Vernacular name. Sarawak—*ketiau badas* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Common and scattered throughout Sabah (e.g., *SAN 27133* and *SAN 32234*) and Sarawak (e.g., *S 8657*, *S 8855*, *S 12362*, *S 27679*, and *S 37629*). Also known from Brunei (e.g., *BRUN 952*, *S 5866*, *S 27679*, *SAN 17437*, and *Sinclair 10472*) and Kalimantan.

Ecology. In transitional fringe forest behind sandy beach vegetation, peat swamp, lowland mixed dipterocarp, *kerangas*, and lower montane forests, at altitudes to 1400 m.

9. **Madhuca daemonica** (Van den Assem) Yii & P.Chai

(Latin, *daemon* = ghost, translation of a Malay word '*hantu*'; inference unknown)

Gard. Bull. Sing. 53 (2001) 344. **Basionym:** *Ganua daemonica* Van den Assem *l.c.* 394. **Type:** *Egar A 0932*, Borneo, Sarawak, Setapok FR (KEP).

Tree to 24 m tall, 50 cm diameter. **Bark** reddish brown mottled, with rows of light brown lenticels, smooth; inner bark reddish brown. **Twigs** slender, *terete*, finely marked with horizontal cracks, *glabrous*. **Stipules** *absent*. **Leaves** *well-spaced along twigs*, *subcoriaceous*, *glabrous on both surfaces*, drying reddish brown; elliptic, 6.5–14.5 × 3–6 cm, base cuneate, margin plane, apex acuminate with a sharp tip; midrib round and raised on both sides; *lateral veins* 14–20 pairs, *ascending at an angle of 75–80° from midrib*, *arching and joining to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate-tessellate near leaf margin, obscure above, prominent below; petiole slender, 1.6–2.5 cm long, subangular, thickened and black at base. **Inflorescences** axillary, 4–7-flowered. **Flowers:** pedicel 0.6–0.9 cm long, hairy; sepals ovate, *c.* 3 × 4 mm, silvery tomentose; *corolla* translucent white, *c.* 4 mm long, *lobes* 7–9, *lanceolate*, apex obtuse; stamens 12–16, *filaments c. 2 mm long*, villous, anthers *c.* 2 mm long, lanceolate; ovary ovoid, villous, style glabrous. **Fruits** *ovoid*, *c. 1.2 × 0.9 cm*, 1-seeded; pericarp thin, smooth. **Seeds** ellipsoid, 0.9 × 0.4–0.5 cm, acute at both ends; testa thin, smooth; *scar* narrowly linear, *c. 7 × 2 mm*.

Vernacular name. Sarawak—*ketiau hantu* (Malay).

Distribution. Endemic to Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN 17437*, *SAN 17448* and *SAN 24305*) and Sarawak (e.g., *S 2618*, *S 4423*, *S 5866*, *S 14462*, *S 30039*, and *S 129965*).

Ecology. In peat swamp, *kerangas* and mixed dipterocarp forests, at altitudes to 700 m.

10. **Madhuca dubardii** H.J.Lam.

(M.M.M. Dubard, 1873–1914, a French botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 162, *l.c.* (1927) 444; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 104; Whitmore, Tantra & Sutisna *l.c.* 319. **Type:** *Agama 538*, Borneo, Sabah (holotype BO; isotype K).

Tree to 16 m tall, 40 cm diameter. **Bark** reddish brown, smooth or scaly; inner bark dull brown. **Twigs** slender, *terete*, *rusty-brown hairy*, glabrescent. **Terminal buds** *c.* 7 mm long, hairy. **Stipules** *triangular*, *c. 1 × 0.5 mm*. **Leaves** *crowded at ends of twigs*, coriaceous, *glabrous above*, *greyish sericeous below*; lanceolate to obovate, 9–28 × 3–8 cm, base cuneate, *margin plane*, apex acuminate with a sharp tip; midrib broadly grooved and narrowly crested above, rounded and prominent below; *lateral veins* 16–25 pairs, ascending at an angle of 75–80° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; *intercostal venation reticulate*, *reticulate-tessellate near leaf margin*, indistinct on both sides; petiole 1.5–2.8 cm long, flat or shallowly grooved on adaxial side, rounded on abaxial side. **Inflorescences** axillary, 2–4-flowered. **Flowers:** pedicel angular, 1.6–2.4 cm long, greyish-brown hairy; sepals ovate, 6–7 × 4–5 mm, apex rounded, greyish hairy; corolla 10–12 mm long, 8-lobed, lobes lanceolate, obtuse; stamens 16, in two whorls, filaments *c.* 2 mm long, anthers *c.* 2 mm long, lanceolate; ovary ovoid, rusty-brown hairy, style glabrous. **Fruits** ellipsoid, 2.3–3 × 1.2–1.5 cm, 1-seeded, acute at both ends; pericarp fleshy, greyish-brown hairy. **Seeds** ellipsoid, 1.5 × 0.6–0.8 cm, acute at both ends; testa thin, smooth; scar linear, *c.* 15 × 2 mm.

Vernacular name. Sabah—*manatu* (Dusun).

Distribution. Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from the east coast of Sabah (e.g., *SAN 8873*, *SAN 16675*, *SAN 29694*, *SAN 39915*, *SAN 42958*, and *SAN 54486*) and the east coast of Kalimantan.

Ecology. In lowland coastal mixed dipterocarp forest, at altitudes to 200 m.

11. **Madhuca elmeri** Merr. *ex* H.J.Lam

(A.D.E. Elmer, 1870–1942, plant collector in Sabah and the Philippines)

Bull. Jard. Bot. Buitenz. 3, 7 (1927) 460; Merrill *l.c.* (1929) 239; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 21; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 319; Argent *et al.* (eds.) *l.c.* 577. **Lectotype** (P. Royen, 1960)**:** *Elmer 21172*, Borneo, Sabah, Tawau (hololectotype PNH; isolectotypes BM, K, L, P, S, SING, U).

Tree to 20 m tall, 30 cm diameter. **Bark** dark greyish brown, smooth or scaly; inner bark brown. **Twigs** slender, subangular or ridged, *densely woolly-tomentose*, glabrescent. **Terminal buds** *c.* 6 mm long, hairy. **Stipules** *shield-shaped*, *c. 6 × 2 mm*, acute, glabrous. **Leaves** *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*, drying reddish brown; elliptic to elliptic-obovate, 13–29 × 4–10 cm, base cuneate, margin plane, apex abruptly acuminate; midrib grooved and narrowly crested above, rounded and prominent below; *lateral veins 18–26 pairs*, ascending at an angle of 65–75° from midrib, *distinctly arching and joining to form intramarginal vein-loops rather far from leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, with a few veins descending from leaf margin and parallel to lateral veins, distinct on both sides; petiole 2–3 cm long, flat or shallowly grooved on adaxial side, densely tomentose.

Inflorescences axillary or in axils of leaf scars, 2–5-flowered. **Flowers:** pedicel angular, 1.3–2 cm long, densely tomentose; *sepals ovate*, *6–7 × 4–5 mm*, apex rounded, hairy; corolla *c.* 6 mm long, 7–9-lobed, lobes lanceolate, obtuse at apex; stamens 16–20, filaments subulate, *c.* 3 mm long, anthers *c.* 2 mm long, oblong; ovary globose, glabrous, style *c.* 10 mm long, glabrous. **Fruits** ellipsoid, 3 × 1.4–1.9 cm, 1-seeded, rounded at both ends; *pericarp fleshy*. **Seeds** ellipsoid, 2.2 × 0.6–1 cm, *pointed at both ends*; testa thin, smooth; scar linear, *c.* 21 × 5 mm.

Distribution. Endemic to Borneo and confined to the east coast of Sabah (e.g., *SAN A 2148*, *SAN 33026*, *SAN 40501*, *SAN 54486*, *SAN 63018*, *SAN 101296*, and *SAN 101346*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

12. **Madhuca endertii** H.J.Lam

(F.H. Endert, 1891–1953, forester at the Forest Research Institute, Bogor, Indonesia)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 458; P. Royen *l.c.* (1960) 75. **Type:** *Endert 4455*, Borneo, Kalimantan, W Kutei, Kemul, Mt. Kong (holotype BO; isotypes K, L).

Tree to 30 m tall, 60 cm diameter. **Twigs** *slender*, *terete*, glabrous. **Terminal buds** *c.* 4 mm long. **Stipules** *ovate-lanceolate*, *c. 2.5 × 1 mm*, acute, pubescent, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; ovate to elliptic-obovate, 5–13 × 3–6 cm, base cuneate and decurrent, margin plane, apex obtuse; midrib stout and prominent on both sides; *lateral veins 6–11 pairs*, *ascending at an angle of 45–55° from midrib*, *diminishing and becoming inconspicuous toward leaf margin* or rarely joined by thickened intercostal veins to form vein-loops near leaf margin, prominent on both sides; *intercostal venation laxly reticulate*, distinct on both sides; *petiole 0.5–2 cm long*, glabrous, *flat on adaxial side*. **Inflorescences** in axils of upper-most leaves, 1–3-flowered. **Flowers:** pedicel angular, 0.15–0.25 cm long, sparsely hairy or glabrous; sepals broadly ovate, *c.* 3 mm across, apex acuminate with an obtuse tip; corolla 7–10 mm long, 6–8-lobed, lobes oblong, apex rounded; stamens 16, in two whorls, filaments subulate, *c.* 2 mm long, villous, anthers oblong, villous, *c.* 2 mm long; ovary globose, *c.* 1.5 mm across, 6–7-loculed, glabrous, style slender, 1–2 mm long, glabrous. **Fruits** ellipsoid, 2.2–4.5 × 0.8–1 cm, 1-seeded, with remnant of style *c.* 2 cm long.

Distribution. Endemic to Borneo. Common in montane forest at Mt. Kinabalu, Sabah (e.g., *RSNB 4087*, *RSNB 4328*; *SAN 24508*, *SAN 32428*, *SAN 56367*, and *SAN 66815*) and Mt. Pueh, Sarawak (e.g., *Stevens 630*). Also occurs in Kalimantan.

Ecology. In lower to upper montane forest, at 1300–3700 m altitudes.

13. **Madhuca engkikiana** Yii & P.Chai Fig. 7.

(Engkik Soepadmo, Coordinator and Chief Editor of the Tree Flora of Sabah and Sarawak project)

Gard. Bull. Sing. 53 (2001) 345. **Type:** *Kodoh SAN 83612*, Borneo, Sabah, Sandakan, Telupid (holotype SAR; isotypes AA, K, KEP, L, SAN, SING).

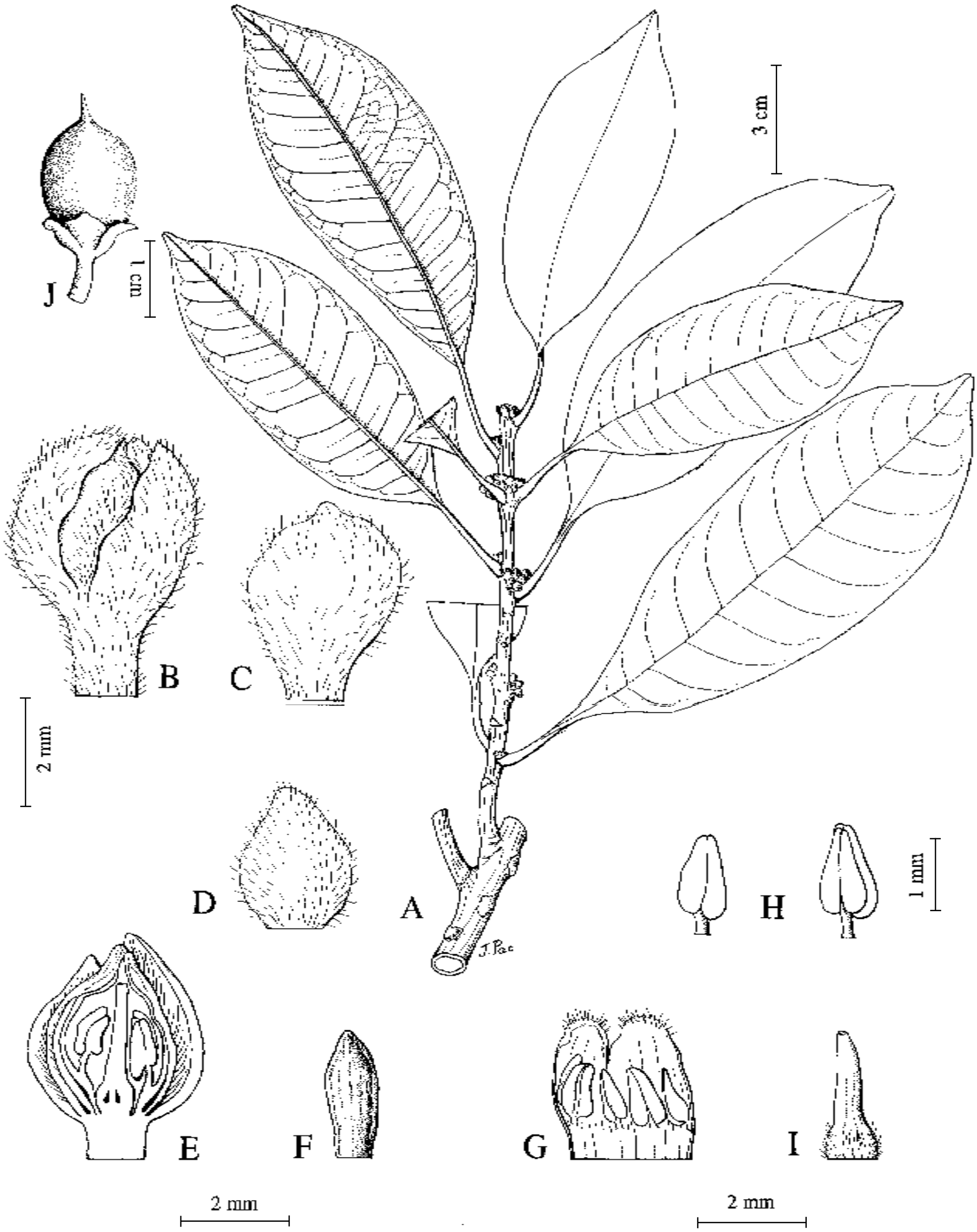

Fig. 7. *Madhuca engkikiana*. A, flowering leafy twig; B, flower bud; C, outer sepal; D, inner sepal; E, longitudinal section of flower bud; F, petal; G, petals and stamens; H, stamens in different views; I, pistil; J, fruit. (A–I from *SAN 83612*, J from *SAN 131963*.)

Tree to 25 m tall, 42 cm diameter. **Bark** reddish grey; inner bark yellowish red. **Sapwood** yellow. **Twigs** slender, *terete*, *glabrous*. **Terminal buds** *c.* 3 mm long, puberulous. **Stipules** *triangular*, *c. 1 × 0.4 mm*. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; elliptic to elliptic-obovate, 9–13 × 3.5–4.8 cm, base cuneate, slightly decurrent and oblique, margin plane, apex short-acuminate; midrib raised on both sides; *lateral veins 11–15 pairs*, *ascending at an angle of c. 80° from midrib*, *distinctly connected by thickened intercostal veins to form intramarginal vein-loops*, *prominent on both sides*; *intercostal venation reticulate*, with a few veins arising from midrib and parallel to lateral veins; *petiole 2–3.5 cm long*, *flat* or *slightly raised on adaxial side*, thickened, black and puberulous at base. **Inflorescences** axillary, 6–8-flowered. **Flowers:** pedicel to 0.3 cm long, yellowish appressed-hairy; sepals suborbicular, *c.* 3 × 2.5 mm, tufted hairy at apex; corolla *c.* 2 mm long, tube *c.* 0.7 mm long, lobes 7, oblanceolate, densely pubescent with tufted yellowish hairs at apex; *stamens 16*, in two whorls, *filaments very short*, anthers lanceolate, *c.* 1 × 0.5 mm, slightly hairy; *ovary subconical*, *c.* 2 mm long, *hairy*, 6–7-loculed, style stout, *c.* 1.5 mm long. **Fruits** (young) *ellipsoid*, laterally compressed, 1.5 × 0.6–1.2 cm, *densely brownish-tomentose*. **Seeds** laterally compressed, pointed at both ends; testa thin, smooth; scar linear.

Distribution. Endemic to Borneo. Only known from four collections from Sabah (*SAN 131963*, *SAN 53982*, *SAN 54205*, and the type).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 250 m.

14. **Madhuca engleri** (Merr.) Vink

(H.G.A. Engler, 1844–1930, a prominent German botanist)

TFSS 4, App. (2002) 355. **Basionym:** *Payena beccarii* Engl., Bot. Jahrb. Syst. 12 (1890) 508, *nom. illeg.*, *non Payena beccarii* Pierre, Bull. Mens. Soc. Linn., Paris (1885) 525; *Payena engleri* Merr. *l.c.* (1921) 477, *l.c.* (1929) 477. **Type:** *Beccari PB 1598*, Borneo, Sarawak, Kuching (holotype FI; isotypes K, P). **Synonym:** *Madhuca beccarii* (Engl.) H.J.Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 177, P. Royen *l.c.* (1960) 52, Anderson *l.c.* 316, Whitmore, Tantra & Sutisna *l.c.* 318.

Tree to 35 m tall, 50 cm diameter. **Twigs** slender, *terete*, *covered with persistent appressed yellowish-brown indumentum*. **Terminal buds** *c.* 3 mm long, rusty-brown hairy. **Stipules** lanceolate, *c. 3 × 1.5 mm*, caducous. **Leaves** *well-spaced along twigs*, *chartaceous* to *subcoriaceous*, *sparsely yellowish-brown appressed tomentose on both sides*; narrowly elliptic to elliptic-obovate, 7–16 × 3.5–6.5 cm, base narrowly cuneate, margin entire and plane, apex acuminate or subcaudate; midrib broadly raised on both sides; *lateral veins 5–9 pairs*, *ascending at an angle of 35–45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *scalariform*, distinct on both sides; petiole 1–2 cm long, flat on adaxial side, thickened at base, sparsely tomentose. **Inflorescences** axillary or in axils of leaf scars, 2–4-flowered. **Flowers:** pedicel 0.6–0.9 cm long, sparsely tomentose; sepals ovate, 4–5 × 3–5 mm, acute; corolla *c.* 6 mm long, lobes 8, lanceolate; stamens 16, filaments very short, anthers oblong; ovary subconical, *c.* 1 mm across, 6–8-loculed, style filiform, glabrous. **Fruits** ellipsoid or obovoid, 2–2.5 × 0.8–1.5 cm, 1-seeded, obtuse; pericarp thin, glabrous. **Seeds** laterally compressed, ellipsoid, 1.5 × 0.6–0.8 cm; scar linear, *c.* 15 × 2 mm.

Vernacular names. Sarawak—*nyatoh padi* (Iban), *nyatoh putih* (Malay).

Distribution. Endemic to Borneo. Only known from Keningau district in Sabah (e.g., *SAN 32450*, *SAN 62914*, *SAN 109956*, and *SAN 118452*) and from Semengoh FR in Sarawak (e.g., *S 215*, *S 1024* and *S 15402*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Uses. The timber is used in heavy construction.

15. **Madhuca erythrophylla** (King & Gamble) H.J.Lam

(Greek, *erythro-* = red, *phullon* = leaves; the reddish or rusty-brown indumentum of the leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 170, *l.c.* (1927) 453; Ridley *l.c.* (1925) 320; P. Royen *l.c.* (1960) 52; Ng *l.c.* 405; Turner *l.c.* 463. **Basionym:** *Bassia erythrophylla* King & Gamble *l.c.* 188, Ridley *l.c.* (1923) 272. **Type:** *Curtis 3652*, Peninsular Malaysia, Penang (holotype SING; isotype K).

Tree to 20 m tall, 30 cm diameter. **Bark** dark brown, smooth; inner bark reddish brown. **Twigs** stout, irregularly ridged, rusty-brown woolly-tomentose, glabrescent. **Terminal buds** to 10 mm long, densely rusty-brown tomentose. **Stipules** linear, *c.* 10 × 1 mm, rusty-brown tomentose, caducous. **Leaves** *crowded at ends of twigs*, coriaceous, *rusty-brown tomentose on both surfaces*, glabrescent, drying reddish brown; elliptic, oblong or obovate, 11–20 × 5–8 cm, base broadly cuneate, slightly oblique, margin plane, apex rounded or acuminate with an obtuse tip; midrib broadly grooved and crested above, round and prominent below; lateral veins 8–13 pairs, stout, ascending at an angle of 70–80° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation densely reticulate, prominent on both sides; petiole 3.5–7 cm long, grooved on adaxial side, round on abaxial side, slightly thickened at base, hairy. **Inflorescences** axillary, 5–6-flowered. **Flowers:** pedicel stout, angular, 1.5–2.5 cm long, densely rusty-brown woolly-tomentose; sepals orbicular, 5–7 mm across, crested; corolla 8–9 mm long, lobes 8, lanceolate, obtuse at apex; stamens 16–18, filaments *c.* 4 mm long, subulate, anthers *c.* 4 mm long, sagittate; ovary *c.* 2 mm across, 8-loculed, hairy, style *c.* 2 mm long, glabrous. **Fruits** subglobose, *c.* 1.2 × 1 cm, 1-seeded, rounded at both ends; pericarp fleshy, densely yellowish-brown tomentose. **Seeds** ellipsoid, 0.9 × 0.5–0.7 cm, pointed at both ends; testa thin, glabrous; scar linear, *c.* 7 × 4 mm.

Distribution. Peninsular Malaysia, Sumatra (Lingga Is.) and Borneo. In Borneo, only known from the Semengoh FR in Sarawak (e.g., *S 8913*, *S 14991*, *S 15135*, *S 15191*, *S 44096*, and *Sinclair 10302*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 100 m.

16. **Madhuca fusca** (Engl.) Forman Fig. 8.

(Latin, *fuscus* = very dark brown; the indumentum)

In Coode *et al.* (eds.), CLBD (1996) 439. **Basionym:** *Illipe fusca* Engl. *l.c.* 510. **Type:** *Beccari PB 3503*, Borneo, Sarawak, Kuching (holotype FI; isotypes L, S). **Synonym:** *Ganua fusca* (Engl.) Merr. *l.c.* (1921) 478, H.J. Lam *l.c.* (1925) 120, *l.c.* (1927) 424, Van den Assem *l.c.* 373.

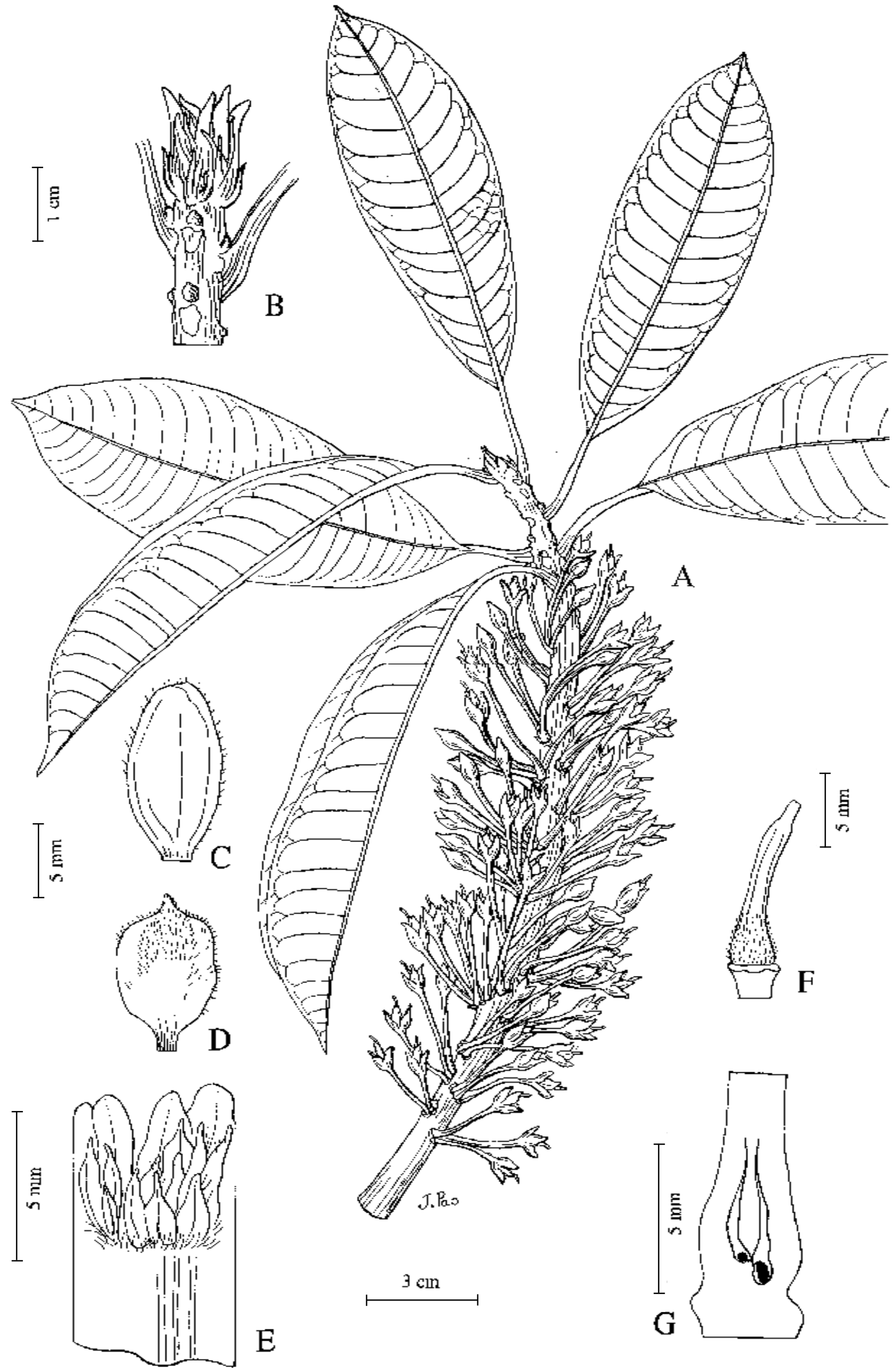

Fig. 8. *Madhuca fusca*. A, flowering leafy twig; B, terminal bud; C, outer sepal; D, inner sepal; E, perianth lobes and stamens; F, pistil; G, longitudinal section of ovary. (All from *Beccari PB 3503*.)

Tree. **Terminal buds** to 14 × 5 mm, with conspicuous bud-scales, sparsely tomentose, glabrescent. **Stipules** *5–7 × 1 mm*. **Leaves** *crowded at ends of twigs*, coriaceous, *glabrous above*, *densely rusty-brown tomentose below*; elliptic to ovate, *11–15 × 4.5–6 cm*, base broadly cuneate, margin plane, apex short-acuminate; midrib impressed above, prominent below; *lateral veins* 12–16 pairs, ascending at an angle of 70–80° from midrib, *arching and joining to form intramarginal vein-loops*, prominent on both sides; *intercostal venation descending from leaf margin and parallel to lateral veins*, reticulate-tessellate near leaf margin, inconspicuous on both sides; petiole 2.5–3.5 cm long, adaxial side narrowly grooved at upper part and flat at lower part, base thickened, rusty-brown tomentose. **Inflorescences** axillary or in axils of leaf scars close to leafy parts of twigs, 2–11-flowered. **Flowers:** pedicel 2.2–2.7 cm long, densely rusty-brown tomentose; sepals ovate, *c.* 8 × 5 mm, apex acute; corolla tube funnel-shaped, glabrous inside, lobes 8, oblong, rounded at apex; stamens 16, filaments short, villous, anthers pilose, mucronate; ovary ovoid, densely rusty-brown hairy at base, 8-loculed, style blunt, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo. In Sarawak, uncommon, only known by the type collection from the vicinity of Kuching. Also occurs in Brunei (e.g., *BRUN 462*).

Ecology. In *kerangas* forest on sandstone ridge, at altitudes to 300 m.

17. **Madhuca glabrescens** H.J.Lam

(Latin, *glabrescens* = becoming glabrous; the leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180, *l.c.* (1927) 462; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 34; Whitmore, Tantra & Sutisna *l.c.* 320. **Type:** *Nieuwenhuis 652*, Borneo, Kalimantan, Sg. Magne (holotype BO).

Tree to 20 m tall, 40 cm diameter. **Bark** reddish brown, scaly; inner bark dull orange. **Twigs** slender, terete, greyish tomentose, glabrescent. **Terminal buds** *c.* 1.5 mm long, greyish tomentose. **Stipules** *broadly ovate*, *c. 1 × 0.5 mm*, acute, greyish tomentose, caducous. **Leaves** *crowded at ends of twigs*, *coriaceous*, *glabrous on both surfaces*, *waxy above*; obovate or obovate-elliptic, 12–19 × 4–7 cm, base cuneate and slightly decurrent, margin plane, apex rounded or acuminate with an obtuse tip; midrib prominent and raised on both sides; *lateral veins* 12–16 pairs, ascending at an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; *intercostal venation* slender, *laxly scalariform*, distinct on both sides; petiole 1.5–3.0 cm long, grooved on adaxial side, rounded on abaxial side, thickened and rugose at base. **Inflorescences** axillary, 3–6-flowered. **Flowers:** pedicel slender, 0.7–1.5 cm long, villous; sepals broadly ovate, 4–5 × 3–5 mm, subacute, crested and villous; corolla *c.* 6 mm long, lobes 8–9, lanceolate, obtuse; stamens 18, filaments very short, densely woolly-tomentose, anthers *c.* 3 mm long, narrowly oblong-ovoid, villous; ovary globose, *c.* 1.5 mm across, 8-loculed, glabrous, style *c.* 5 mm long, glabrous. **Fruits** ellipsoid-oblong, 8–10 × 2 cm, laterally compressed, 1-seeded, acute at both ends; pericarp fleshy, densely yellowish-brown tomentose. **Seeds** laterally compressed, ellipsoid, 1.8 × 0.5–0.8 cm, pointed at both ends; testa thin, glabrous; scar broadly linear, *c.* 18 × 1.5 mm.

Vernacular names. Sarawak—*nyatoh daun licin* (Malay and Iban). Kalimantan—*maligalas* (Rongos).

Distribution. Endemic to Borneo. Common in Sabah (e.g., *SAN 3338*, *SAN 16009*, *SAN 27070*, *SAN 44684*, *SAN 71502*, *SAN 92354*, *SAN 118434*, and *SAN 129720*). Also occurs in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest.

18. **Madhuca hirtiflora** (Ridl.) H.J.Lam

(Latin, *hirtus* = hairy, *florus* = flower; with hairy flowers)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 160, *in* Ridley *l.c.* (1925) 319, *l.c.* (1927) 444; Ng *l.c.* 398; Turner *l.c.* 463. **Basionym:** *Bassia hirtiflora* Ridl. *l.c.* (1923) 266. **Type:** *Md. Haniff & Md. Nur 6949*, Peninsular Malaysia, Perak, Sg. Siput (holotype SING). **Synonym:** *Ganua hirtiflora* (Ridl.) P.Royen *l.c.* (1960) 112, Ng *l.c.* 398, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317.

Tree to 15 m tall, 15 cm diameter. **Bark** greyish brown, smooth or scaly; inner bark dull orange. **Twigs** stout, *ridged* or *angular*, *densely woolly-tomentose on nodes.* **Terminal buds** *12–15 mm long*, greyish woolly-pilose. **Stipules** *lanceolate*, *c. 12 × 5 mm*, acute, crested, greyish pilose. **Leaves** *crowded at ends of twigs*, coriaceous, *glabrous on both surfaces*, drying reddish brown; *broadly obovate*, 17–34 × 7.5–15 cm, base cuneate and slightly decurrent, *margin erose* (*gnawed*), apex acuminate with an obtuse tip or rounded; midrib shallowly grooved and broadly crested above, stout and prominent below; *lateral veins 19–25 pairs*, ascending at an angle of 80–90° from midrib, *joined by thickened intercostal veins to form intramarginal vein-loops*, prominent on both sides; *intercostal venation densely reticulate-tessellate*, distinct above, prominent below; *petiole 5–8 cm long*, flat or broadly grooved on adaxial side, thickened and rugose at base, glabrous. **Inflorescences** in axils of leaf scars, 4–6-flowered. **Flowers:** pedicel stout, 0.5–1 cm long, densely greyish-tomentose; *sepals oblanceolate*, *c*. 10 × 6 mm, acute, crested, pilose; corolla *c*. 12 mm long, lobes 8, lanceolate, obtuse; stamens 15–18, filaments *c*. 7 mm long, anthers *c*. 8 mm long, oblong-ovoid; ovary globose, *c*. 2 mm across, 8-loculed, glabrous; style twice as long as corolla. **Fruits** *ellipsoid*, *c*. 2.5 × 1 cm, greyish pilose. **Seeds** unknown.

Vernacular name. Sarawak—*nyatoh kusta* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, uncommon and only known from the Semengoh FR (e.g., *S 3375*, *S 37978*, *S 40533*, and *Pennington 10264*). Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest on sandy loam soils, at altitudes below 150 m.

19. **Madhuca kingiana** (Brace *ex* King & Gamble) H.J.Lam

(Sir George King, 1840–1909, British botanist and sometimes superintendent of the Calcutta Botanic Gardens, India)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 159; Ridley *l.c.* (1925) 319; Pennington *l.c.* 157; PROSEA *l.c.* 289; Kessler & Sidiyasa *l.c.* 213; Turner *l.c.* 463; Coode *et al.* (eds.) *l.c.* 306. **Basionym:** *Bassia kingiana* Brace *ex* King & Gamble *l.c.* 178, Ridley *l.c.* (1923) 267. **Lectotype** (P. Royen, 1960)**:** *King's Collector 3314*, Peninsular Malaysia, Perak, Larut (hololectotype SING). **Synonyms:** *M. glaberrima* H.J.Lam *l.c.* (1925) 263, Merrill *l.c.* (1929) 239; *Ganua glaberrima* (H.J.Lam) H.J.Lam *l.c.* (1927) 428, Masamune *l.c.* 588;

G. kingiana (Brace *ex* King & Gamble) Van den Assem *l.c.* 373, P. Royen *l.c.* (1960) 112, Ng *l.c.* 399, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 316.

Tree to 20 m tall, 20 cm diameter. **Bark** greyish brown, smooth or scaly; inner bark brown. **Twigs** stout, subangular, rusty-brown hairy, glabrescent. **Terminal buds** *c.* 10 mm long. **Stipules** triangular, *5–10 × 4–8 mm*, crested outside, rusty-brown hairy. **Leaves** *crowded at ends of twigs*, *coriaceous*, *glabrous on both surfaces*; oblong or oblanceolate, 18–33 × 6–13 cm, base broadly cuneate and slightly oblique, margin plane, apex short-acuminate; midrib grooved and narrowly crested above, round and prominent below; *lateral veins* 18–30 pairs, ascending at an angle of 75–85° from midrib, *arching and joining into a smooth intramarginal vein*, impressed above, prominent below; *intercostal venation densely scalariform*, prominent on both sides; petiole 3.5–5 cm long, grooved on adaxial side, thickened and rugose at base, glabrous. **Inflorescences** in axils of leaf scars, 3–6-flowered. **Flowers:** pedicel stout, 0.5–0.9 cm long, densely rusty-brown tomentose; sepals broadly ovate, *c.* 10 × 8 mm, subacute, crested; corolla *c.* 12 mm long, lobes 12–16, lanceolate, obtuse; stamens 24–36, filaments *c.* 7 mm long, anthers *c.* 8 mm long, oblong-ovoid; ovary globose, *c.* 2 mm across, 8–10-loculed, glabrous, style twice as long as corolla. **Fruits** subglobose or broadly ellipsoid, 2–2.5 × 1–1.5 cm, 1-seeded, rusty-brown tomentose; stalk to 3 cm long; pericarp fleshy. **Seeds** ellipsoid, *c.* 1.5 × 1 cm, pointed at both ends; testa glabrous, brown; scar oblanceolate, *c.* 15 × 1 mm, covering about one third of seed surface.

Vernacular name. Sabah—*nyatoh king* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, common and scattered throughout Sabah (e.g., *SAN 15375*, *SAN 16824*, *SAN 37922*, *SAN 76018*, *SAN 95187*, and *SAN 129720*) and Sarawak (e.g., *S 10298*, *S 14963*, *S 29460*, *S 37987*, and *S 46553*). Also occurs in Brunei (e.g., *BRUN 3317*) and Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes below 150 m.

20. **Madhuca korthalsii** (Pierre *ex* Burck) H.J.Lam

(P.W. Korthals, 1807–1892, a Dutch botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 168 & 264, *l.c.* (1927) 449; Ridley *l.c.* (1925) 320; Masamune *l.c* 591; P. Royen *l.c.* (1960) 87; Burgess *l.c.* 449; Ng *l.c.* 406; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 320; Pennington *l.c.* 157; PROSEA *l.c.* 289; Turner *l.c.* 463; Argent *et al.* (eds.) *l.c.* 577. **Basionym:** *Bassia korthalsii* Pierre *ex* Burck, Ann. Jard. Bot. Buitenz. 5 (1885) 45. **Type:** *Korthals s.n.*, Sumatra (holotype L; isotype BO). **Synonyms:** *Illipe korthalsii* (Pierre *ex* Burck) Engl. *l.c.* 509; *Vidoricum korthalsii* (Pierre *ex* Burck) Kuntze, Revis. Gen. Pl. 2 (1891) 407; *Bassia braceana* King & Gamble *l.c.* 184, Ridley *l.c.* (1923) 270; *Kakosmanthus korthalsii* (Pierre *ex* Burck) Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 198.

Tree to 35 m tall, 50 cm diameter. **Bark** light to dark brown, scaly to flaky; inner bark reddish orange. **Twigs** *slender*, terete or subangular, *greyish velvety-hairy*, glabrescent. **Terminal buds** 1.5–2 mm long. **Stipules** triangular, *c. 2 × 1 mm*, acute and crested, velvety hairy, more or less persistent. **Leaves** *well-spaced along twigs*, coriaceous, *glabrous on both surfaces*, drying dull blackish-brown below; elliptic or elliptic-obovate, 9–24 × 6–10 cm, base cuneate, slightly decurrent and oblique, margin plane, apex rounded or acuminate with an obtuse tip; midrib flat or slightly raised above, rounded and prominent below; *lateral veins* 11–18 pairs, ascending at an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, raised and prominent above, stronger below; *intercostal venation* slender, *laxly scalariform*, distinct on both sides; *petiole* 1.5–4 cm long, narrowly grooved on adaxial side, round on abaxial side, thickened, rugose and *puberulous at base*. **Inflorescences** axillary or on warts scattered along branchlets, 2–5-flowered. **Flowers:** pedicel slender, 0.6–1.5 cm long, greyish velvety; sepals ovate, *c.* 5 × 4 mm, greyish velvety; *corolla* white, *c. 6 mm long*, *lobes 8*, *ovate*; *stamens 18*, rusty-brown hirsute, filaments *c.* 1.5 mm long, *anthers oblong-ovoid*, *c.* 2 mm long; ovary ovoid, *c.* 1.5 mm across, 8-loculed; style *c.* 10 mm long, glabrous. **Fruits** *ellipsoid*, 2–3 × 1–2 cm, 1-seeded; pericarp fleshy and glabrous. **Seeds** laterally compressed, ellipsoid, 1.8 × 0.5–0.8 cm, pointed at both ends; testa thin, glabrous; scar linear, *c.* 18 × 1.5 mm.

Vernacular name. Sarawak—*kayu pak-peting* (Punan).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, common and scattered throughout Sabah (e.g., *SAN 20101*, *SAN 42567*, *SAN 55520*, *SAN 88748*, *SAN 118732*, and several others) and Sarawak (e.g., *S 3438* and *S 39493*). Also occurs in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest, at altitudes to 600 m.

21. **Madhuca kuchingensis** Yii & P.Chai

(of Kuching, Sarawak)

Gard. Bull. Sing. 53 (2001) 344. **Type:** *Beccari PB 2241*, Borneo, Sarawak, Kuching (holotype FI; isotype L). **Synonym:** *Ganua beccarii* Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 408, H.J. Lam *l.c.* (1925) 130, *l.c.* (1927) 429, Masamune *l.c.* 588, Van den Assem *l.c.* 380, Anderson *l.c.* 315.

Tree to 20 m tall, 30 cm diameter. **Bark** greyish brown, smooth to scaly; inner bark dull orange. **Twigs** slender, terete, *rusty-brown velvety-hairy*, glabrescent. **Terminal buds** *c. 2 mm long*, hairy. **Stipules** *c. 2 × 1 mm*, velvety hairy, caducous. **Leaves** *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*; *elliptic* to *oblong-elliptic*, 10–17 × 3–5 cm, base narrowly cuneate and slightly decurrent, margin plane, apex acuminate, acumen *c.* 10 mm long; midrib prominently raised on both sides; *lateral veins 11–13 pairs*, ascending at an angle of 60–70° from midrib, *arching and joined by thickened intercostal veins to form intramarginal vein-loops*, slender and faintly impressed above, prominent below; *intercostal venation* slender, *densely reticulate*, with few veins descending from leaf margin and parallel to lateral veins, faintly impressed above, distinct below; *petiole 2–3 cm long*, flat or slightly crested on adaxial side, round on abaxial side. **Inflorescences** axillary, *5–8-flowered*. **Flowers:** pedicel slender, 0.6–1 cm long, appressed hairy; sepals suborbicular, 4–5 mm across, subacute; *corolla* 3–4 mm long, *lobes 8*, lanceolate, obtuse; *stamens 16*, *in two whorls*, pilose, filaments very short, anthers *c.* 1 mm long, oblong; ovary globose, *c.* 1.5 mm across, 8-loculed, pilose; style *c.* 8 mm long, glabrous. **Fruits** laterally compressed, ellipsoid, 2 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, densely yellowish tomentose. **Seeds** laterally compressed, ellipsoid, 1.8 × 0.5–0.8 cm, pointed at both ends; testa thin and glabrous; scar linear, *c.* 18 × 1.5 mm.

Distribution. Endemic to Borneo and confined to the central and western parts of Sarawak (e.g., *S 3356*, *S 4307*, *S 14846*, *S 24344*, *S 27064*, and *S 32394*).

Ecology. In primary lowland *kerangas* and mixed dipterocarp forests, at altitudes to 100 m.

22. **Madhuca lancifolia** (Burck) H.J.Lam

(Latin, *lanci-* = lance-shaped, *folium* = leaf; with lanceolate leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 158, *l.c.* (1927) 444; Ridley *l.c.* (1925) 319; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 18; Whitmore, Tantra & Sutisna *l.c.* 320; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Payena lancifolia* Burck, Med.'s Lands Pl. Buitenz. 3 (1886) 41. **Type:** *Teijsmann 8648*, Borneo, Kalimantan, Sintang (holotype BO; isotypes K, L).

Tree to 14 m tall, 15 cm diameter. **Bark** brown, slightly flaky; inner bark reddish brown, soft. **Twigs** stout, *subangular*, *densely rusty-brown tomentose*. **Terminal buds** to 10 mm long. **Stipules** *lanceolate*, *c. 9 × 2 mm*, pubescent, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, dark glossy green above, *densely golden-brown pubescent below*; *lanceolate* or *elliptic-oblong*, 15–55 × 5.5–15 cm, base broadly cuneate and decurrent, margin plane, apex obtuse or acuminate with pointed tip; midrib broadly grooved and narrowly crested above, prominent below; *lateral veins 22–50 pairs*, *ascending at an angle of 70–75° from midrib*, *arching and joining to form vein-loops near leaf margin*, *prominent on both sides*; *intercostal venation* slender, *scalariform*, with some veins descending from leaf margin and parallel to lateral veins, prominent above, stronger below; *petiole 3.5–7 cm long*, *broadly furrowed on adaxial side*, round on abaxial side, thickened at base, pubescent, glabrescent. **Inflorescences** axillary, 5–10-flowered. **Flowers:** pedicel angular, 1.2–1.6 cm long, densely tomentose; *sepals triangular*, *5–7 mm long*, acute; *corolla c. 7 mm long*, lobes 10–14, lanceolate; *stamens 22–28*, in 2 whorls, *filaments* subulate, *c. 0.5 mm long*, rusty-brown hirsute, *anthers ovate-lanceolate*, *c. 2 mm long*; *ovary subconical*, *c.* 3 mm long, 8–14-loculed, pilose, *style clavate-subulate*, *8–9 mm long*. **Fruits** unknown.

Vernacular names. Sarawak—*nyatoh beludu* (Iban). Brunei—*jangkar sakat* (Iban), *terkam balau* (Murut).

Distribution. Endemic to Borneo. Uncommon, only known by a few collections from Kinabatangan district in Sabah (e.g., *SAN 16864*), Semengoh FR in Sarawak (e.g., *Sinclair 10177*) and Brunei (e.g., *FMS 35476*).

Ecology. In lowland mixed dipterocarp forest, in marshy habitats along streams and gullies.

23. **Madhuca malaccensis** (C.B.Clarke) H.J.Lam

(of Malacca, Peninsular Malaysia)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 167, *l.c.* (1927) 449; Ridley *l.c.* (1925) 319; Merrill *l.c.* (1929) 239; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 44; Ng *l.c.* 407; Whitmore, Tantra & Sutisna *l.c.* 320; PROSEA *l.c.* 291; Turner *l.c.* 464; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Payena malaccensis* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 547. **Type:** *Griffith 3610*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Bassia malaccensis* (C.B.Clarke) King & Gamble *l.c.* 180, Ridley *l.c.* (1923) 268; *Dasyaulus malaccensis* (C.B.Clarke) Dubard, Rev. Gen. Bot. 20 (1908) 201.

Tree to 25 m tall, 45 cm diameter. **Bark** greyish brown, smooth to scaly; inner bark reddish brown. **Twigs** *stout*, subangular, *rusty-brown velvety hairy at tips*. **Terminal buds** to 5 mm long, velvety hairy. **Stipules** *minute*, lanceolate, caducous. **Leaves** *well-spaced along twigs*, coriaceous, *glabrous on both surfaces*; obovate to elliptic-obovate, 13–32 × 6.5–15 cm, base cuneate to broadly cuneate, margin plane, apex obtuse or acuminate with a sharp tip; midrib broad and prominent on both sides; *lateral veins* 11–17 pairs, ascending at an angle of *c.* 60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *scalariform-tessellate*, distinct on both side, stronger below; *petiole* 2–5 cm long, broadly grooved on adaxial side, round on abaxial side, distinctly thickened at base, *glabrous*. **Inflorescences** axillary, rarely in axils of leaf scars, 4–8-flowered. **Flowers:** pedicel angular, *c.* 1.5 cm long, hairy; sepals ovate, 6–7 × 4–6 mm, subobtuse; *corolla c. 12 mm long*, *lobes 10–12*, *elliptic-lanceolate*; *stamens 22–25*, filaments subulate, 1–1.5 mm long, *anthers sagittate*, *c.* 3 mm long; ovary subconical, 4–6 mm long, 8-loculed, glabrous, style subulate. **Fruits** *oblong-obovoid*, 2–2.7 × 1.2–1.5 cm, 1-seeded, rounded at apex and crowned with a persistent style, base cuneate; pericarp thin and glabrous. **Seeds** oblong, *c.* 1.5 × 0.8 cm, acute at both ends; scar linear, up to 5 mm broad.

Vernacular name. Sabah—*nyatoh kemayan* (Malay).

Distribution. S Thailand, Sumatra (Bangka), Peninsular Malaysia, Singapore, and Borneo. In Borneo, restricted to the east coast of Sabah (e.g., *SAN 24749*, *SAN 34881*, *SAN 54606*, *SAN 60872*, and *SAN 99999*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

24. **Madhuca markleeana** Yii & P.Chai Fig. 9.

(Mark Lee Hua Seng, Deputy Director of the Forestry Department, Sarawak)

Gard. Bull. Sing. 53 (2001) 347. **Type:** *Yii S 72728*, Borneo, Sarawak, Bt. Meluku (holotype SAR; isotypes K, KEP, L, SAN).

Tree to 15 m tall, 25 cm diameter, with very low buttresses. **Bark** chocolate brown with greyish green mottles, smooth to finely fissured; inner bark *c.* 4 mm thick, dull orange, granular. **Twigs** *terete*, *rusty-brown velvety hairy at tips*, glabrescent. **Terminal buds** to 8 mm long; bud-scales elliptic, 10–14 × 9–11 mm. **Stipules** *lanceolate*, *c. 10 × 3 mm*, velvety hairy, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; lanceolate or oblong, 25–35 × 7–8 cm, base broadly cuneate and slightly oblique, margin plane, apex obtuse or acuminate with a sharp tip; midrib broadly crested above, prominent below; *lateral veins 28–35 pairs*, *ascending at an angle of 75–85° from midrib*, straight at first and then *arching and joining at tips to form vein-loops rather far from leaf margin*, impressed above, prominent below; *intercostal venation* slender, *scalariform*, with some veins descending from leaf margin and parallel to lateral veins, faint above, distinct below; *petiole 1.5–2.5 cm long*, flat on adaxial side, round on abaxial side, velvety hairy, glabrescent. **Inflorescences** axillary, 3–5-flowered. **Flowers:** pedicel subangular, 5–6 cm long, pale green, sparsely pubescent; *sepals suborbicular*, *c. 10 × 14 mm*, outer pair with recurved margin, inner pair smaller, margin not recurved, pubescent; *corolla* white, *c. 12 mm long*, lobes 8, lanceolate, 7–8 mm long, apex acute, tube *c.* 4 mm long, slightly pubescent at the throat; stamens 19, in 2 whorls, *filaments* subulate, *c. 5 mm long*, anthers sagittate, yellowish, *c.* 5 mm long; *ovary disciform*, *c.* 3 × 5 mm, 8-loculed, pilose, style filiform, pale green, tapering

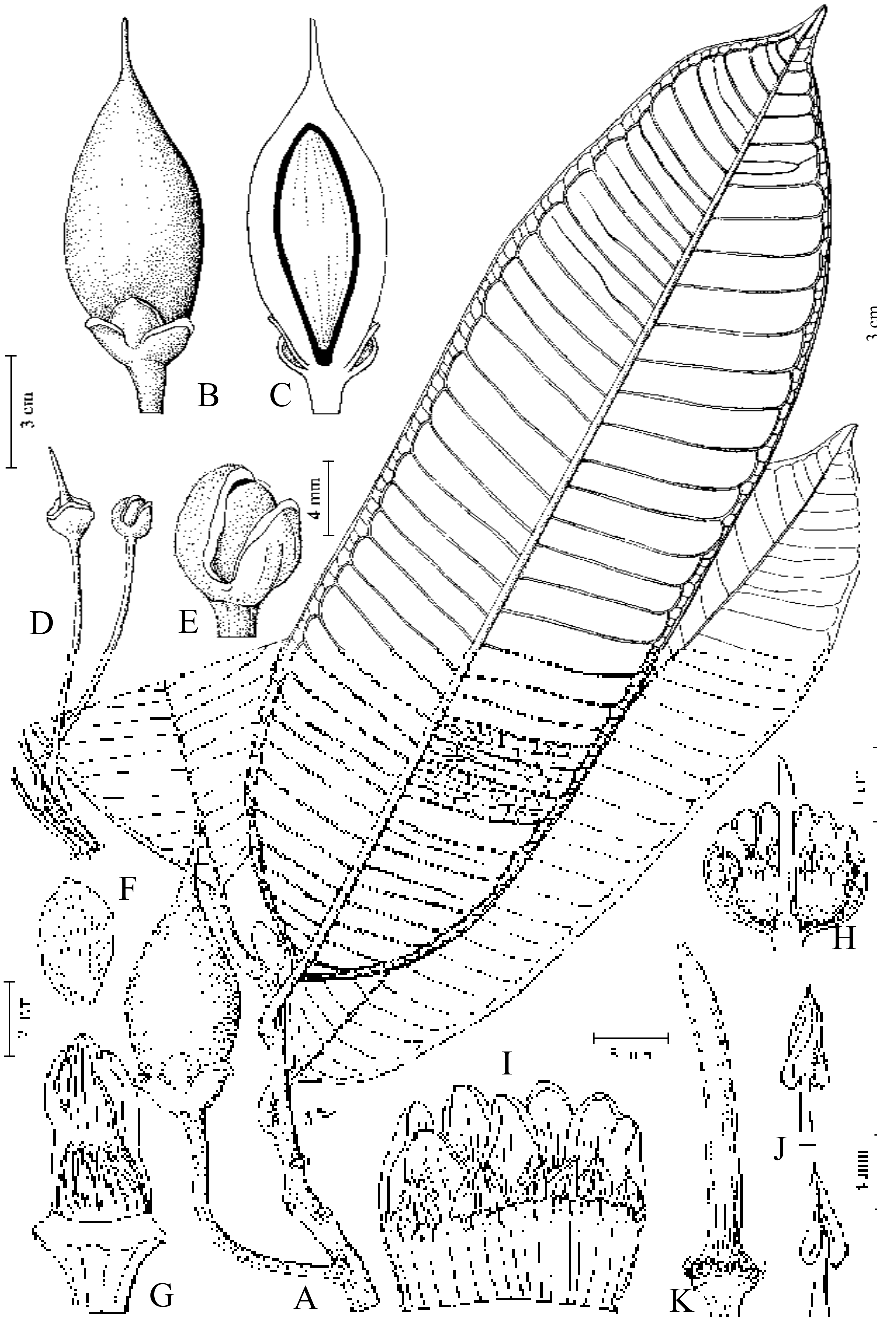

Fig. 9. *Madhuca markleeana.* A, fruiting leafy twig; B, fruit; C, longitudinal section of fruit; D, part of inflorescence; E, flower bud; F, petal; G, flower bud with sepals and a few petals removed; H, longitudinal section of flower bud; I, petals and stamens; J, stamens in different views; K, pistil. (A–C from *S 72729*, D–K from *S 72728.*)

towards stigma. **Fruits** ellipsoid, *c.* 7 × 4 cm, 1-seeded, tapering at both ends; pericarp thick and fleshy, green, densely brown tomentose; stalk 7–8 cm long. **Seeds** ellipsoid, 4.5 × 1.2–2 cm, pointed at both ends; testa thin and glabrous; scar narrowly linear, *c.* 43 × 3 mm.

Vernacular name. Sarawak—*nyatoh gasing* (Malay).

Distribution. Endemic to Borneo and confined to Sarawak; only known from the type collection and *S 72729*.

Ecology. Understorey tree on steep slopes of lowland mixed dipterocarp forest, at altitudes to 400 m.

25. **Madhuca mindanaensis** (Merr.) Merr.

(of Mindanao, the Philippines)

Enum. Philip. Fl. Pl. 3, 3 (1923) 277, *l.c.* (1929) 238; H.J. Lam *l.c.* (1925) 175, *l.c.* (1927) 455; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 19; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 320. **Basionym:** *Bassia mindanaensis* Merr., Philip. J. Sci. Bot. 10 (1915) 58. **Type:** *Miranda FB 17977*, the Philippines, Mindanao (PNH†); **neotype** (P. Royen, 1960)**:** *Elmer 20596*, Borneo, Sabah, Tawau, Elphinstone (holoneotype L; isoneotypes BM, K, P, SING, U).

Tree to 20 m tall, 25 cm diameter. **Bark** greyish brown, smooth to papery and scaly; inner bark dull orange. **Twigs** whitish, slender, terete or subangular, sparsely hairy, glabrescent. **Terminal buds** to 4 mm long. **Stipules** lanceolate or triangular, *c.* 8 mm long, hairy, caducous. **Leaves** *well-spaced along twigs*, *chartaceous*, glabrous on both surfaces; elliptic, obovate, or rarely oblanceolate, 14–28 × 3.5–10 cm, base cuneate and decurrent, margin plane, apex acuminate with a sharp tip; midrib grooved and broadly crested above, prominent and rounded below; *lateral veins* 9–17 pairs, *ascending at an angle of 45–50° from midrib*, *arching and joining at tips to form vein-loops rather far from leaf margin*, impressed above, stout and prominent below; intercostal venation slender, densely scalariform, faint above, distinct below; petiole 1–3 cm long, shallowly grooved on adaxial side, round on abaxial side, thickened and rugulose at base. **Inflorescences** axillary or on warts of leaf scars, 2–9-flowered. **Flowers:** pedicel slender, angular, 0.5–1.5 cm long, velvety hairy; sepals broadly ovate, 6–8 × 4–6 mm, greyish-yellow tomentose; corolla 9–11 mm long, lobes 8, oblanceolate, apex acute; stamens 15(–30), filaments subulate, *c.* 1.5 mm long, anthers sagittate *c.* 1 mm long; ovary disciform, *c.* 1 × 1.5 mm, 8-loculed, pilose, style filiform, 8–10 mm long. **Fruits** fusiform, 2–3.3 × 1–1.2 cm, 1-seeded, acute at both ends, drying black; pericarp thin and glabrous. **Seeds** ellipsoid, 2–2.7 × 0.6–0.8 cm, acute at both ends; testa thin, glabrous; scar narrowly linear, *c.* 10 × 3.5 mm.

Vernacular name. Sabah—*antagiras* (Dusun, Sandakan).

Distribution. Borneo and the Philippines. In Borneo, common in the east coast of Sabah (e.g., *SAN 457*, *SAN 3426*, *SAN 19391*, *SAN 22666*, and *SAN 66689*). Also occurs in Kalimatan (e.g., *Kostermans 21702*).

Ecology. Understorey trees of lowland mixed dipterocarp and riverine forest, at altitudes to 160 m.

26. **Madhuca montana** P.Royen

(Latin, *montanus* = pertaining to mountain; confined to montane habitat)

Blumea 10 (1960) 76. **Type:** *Clemens 30861*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes BM, K).

Tree to 33 m tall, 55 cm diameter. **Twigs** *slender*, *brownish velvety*, glabrescent. **Terminal buds** to 3 mm long. **Stipules** lanceolate-ovate, *c. 2.5 × 1 mm*, acute, velvety, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, *densely hairy*, glabrescent; elliptic or elliptic-obovate, 7–9 × 3–4 cm, base cuneate and decurrent, margin plane, *apex obtuse*; midrib broadly raised above, less prominent below; *lateral veins 8–10 pairs*, *ascending at an angle of c. 60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, sometimes joined by thickened intercostal veins to form intramarginal vein-loops, *obscure above*, *distinct below*; *intercostal venation laxly scalariform*, usually more distinct above than below; *petiole 0.8–1 cm long*, flat on adaxial side, round on abaxial side, rugose. **Inflorescences** axillary, *1–3-flowered*. **Flowers:** pedicel angular, 0.7–1.2 cm long, greyish hairy; sepals broadly ovate, *c.* 3 mm across, apex acute; corolla *c.* 3 mm long, lobes 8, oblong, apex rounded; stamens 16, villous, filaments subulate, *c.* 0.2 mm long, *anthers oblong*, *c. 0.6 mm long*; *ovary disciform*, *c.* 0.5 × 1 mm, glabrous, style stout and glabrous, *c.* 1 mm long. **Fruits** unknown.

Distribution. Endemic to Borneo. So far known only from Mt. Kinabalu in Sabah (e.g., *SAN 32317*, *SAN 33127* and *SAN 76524*) and G. Pueh in Sarawak (e.g., *S 46380*).

Ecology. In lower to upper montane forest, at altitudes to 4000 m.

27. **Madhuca monticola** (Merr.) Merr.

(Latin, *monticolus* = mountain dweller; a species confined to montane habitat)

Enum. Philip. Fl. Pl. 3, 3 (1923) 227; H.J. Lam *l.c.* (1925) 180. **Basionym:** *Bassia monticola* Merr., Philip. J. Sci. Bot. 10 (1915) 56. **Type:** *Merrill 9622*, the Philippines, Palawan, Silanga (BM, L, NSW). **Synonym:** *Ganua monticola* (Merr.) H.J.Lam *in* Van den Assem *l.c.* 379.

Tree. **Twigs** *glabrous*, greyish, subangular, smooth or with warty inflorescence scars. **Terminal buds** *c. 5 mm long*. **Stipules** *c. 2 mm long*, caducous. **Leaves** *crowded at ends of twigs*, *subcoriaceous*, *glabrous on both surfaces*, *drying reddish brown*; *oblong* or *oblong-lanceolate*, 8.5–16 × 3–6.5 cm, base cuneate, margin plane, apex short-acuminate; midrib prominently raised on both sides; *lateral veins* slender, 13–18 pairs, ascending at an angle of 65–75° from midrib, *arching and joining into a smooth vein near leaf margin*, obscure above, distinct below; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate near leaf margin, *obscure on both sides*; petiole 1–3 cm long, broadly grooved on adaxial side, round on abaxial side, black and thickened towards base. **Inflorescences** in axils of leaf scars, 5–8-flowered. Fully developed flowers unknown; *pedicel* slender, *1.5–2.5 cm long*, glabrous. **Fruits** ovoid to oblong-ovoid. **Seeds** unknown.

Distribution. Borneo and the Philippines. In Borneo, uncommon, only known by one collection (*Haviland & Hose 1261*) from the vicinity of Kuching in Sarawak.

28. **Madhuca motleyana** (de Vriese) J.F.Macbr.

(James D. Motley, ?–1859, engineer and plant collector, mainly in Borneo)

Contr. Gray Herb. Hav. Univ., NS. 53 (1918) 18; Ridley *l.c.* (1925) 320; Pennington *l.c.* 158; PROSEA *l.c.* 297; Kessler & Sidiyasa *l.c.* 213; Turner *l.c.* 464; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Isonandra motleyana* de Vriese, Nat. Tijds. Ned. Ind. 21 (1860) 308. **Type:** *Motley 857*, Borneo, Kalimantan, Banjarmasin (holotype P; isotype L). **Synonyms:** *Sideroxylon glabrescens* Miq., Fl. Ind. Bat., Suppl. (1860) 44, King & Gamble *l.c.* 187, Ridley *l.c.* (1923) 271; *Bassia motleyana* (de Vriese) C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 546; *Payena latifolia* Burck *l.c.* (1886) 58; *P. rubropedicellata* Burck *l.c.* 55; *P. bankensis* Burck *l.c.* 54; *Illipe motleyana* (de Vriese) Engl., Bot. Jahrb. 12 (1890) 509; *Ganua motleyana* (de Vriese) Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 202, Merrill *l.c.* (1921) 478, H.J. Lam *l.c.* (1925) 122, *l.c.* (1927) 424, Masamune *l.c.* 588, Van den Assem *l.c.* 382, Van den Assem & Kostermans *l.c.* 482, P. Royen *l.c.* (1960) 112, Ng *l.c.* 399, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c* 317.

Tree to 28 m tall, 50 cm diameter; sometimes with small buttresses or pneumatophores. **Bark** greyish brown, smooth to scaly; inner bark dull orange. **Twigs** stout, *terete*, *densely greyish-brown tomentose*. **Terminal buds** small, rusty-brown velvety hairy. **Stipules** *absent.* **Leaves** *well-spaced along twigs*, *thickly coriaceous*, glabrous above, *densely rusty-brown velvety tomentose below*, glabrescent; *ovate-elliptic*, rarely obovate, 6–11 × 3–6 cm, base broadly cuneate, margin plane, apex short-acuminate; midrib prominently raised on both sides; *lateral veins* 13–16 pairs, *ascending at an angle of c. 80° from midrib*, *arching and joining into vein-loops near leaf margin*, obscure above, distinct below; *intercostal venation descending from leaf margin and parallel to lateral veins*, reticulate-tessellate toward leaf margin, obscure above, prominent below; petiole subangular, 1.3–3 cm long, black at base. **Inflorescences** axillary, 3–12-flowered. **Flowers:** *pedicel* 0.8–1.5 cm long, *glabrous*; *sepals ovate*, *c. 4 mm long*, velvety hairy; *corolla c.* 5 mm long, *lobes* 8–10, *obovate*, velvety hairy; stamens 16–20, *filaments very short*, anthers shortly mucronate, *c.* 1 mm long; ovary elongated subconical, 6–8-loculed, style short, glabrous. **Fruits** *subglobose* or ellipsoid, *c. 2.5 × 1.5 cm*, *glabrous*, ripening yellow then reddish, 1-seeded. **Seeds** ellipsoid, 2 × 0.8–1 cm; testa glabrous; *scar* broadly lanceolate, *c. 18 × 4 mm*.

Vernacular name. Sabah and Sarawak—*ketiau paya* (Malay and Melanau).

Distribution. Peninsular Thailand, Sumatra (Riau, Belitung), Peninsular Malaysia and Borneo. Common and scattered throughout Sabah (e.g., *SAN 354*, *SAN 26819*, *SAN 47858*, *SAN 66712*, and *SAN 80660*) and Sarawak (e.g., *S 22*, *S 3900*, *S 8402*, *S 13989*, and *S 34167*). Also occurs in Brunei and Kalimantan.

Ecology. Widely distributed from coastal freshwater swamp and wet *kerangas* forests at sea level to hill mixed dipterocarp and sandstone *kerangas* forests at altitudes to 800 m.

Uses. *M. motleyana* produces moderately hard reddish *nyatoh* timber, suitable for making solid doors, cabinets and furniture. It also produces latex quite freely. The seeds produce *ketiau* fat, used by the local people for cooking and lighting.

29. **Madhuca multinervia** Yii & P.Chai Fig. 10

(Latin, *multi-* = many, *nervis* = nerves; many-veined, the leaves)

Gard. Bull. Sing. 53 (2001) 349. **Type:** *Dewol SAN 97008*, Borneo, Sabah, Tongod, Bt. Pantagaluang (holotype SAR; isotypes BO, K, KEP, L, SAN, SING).

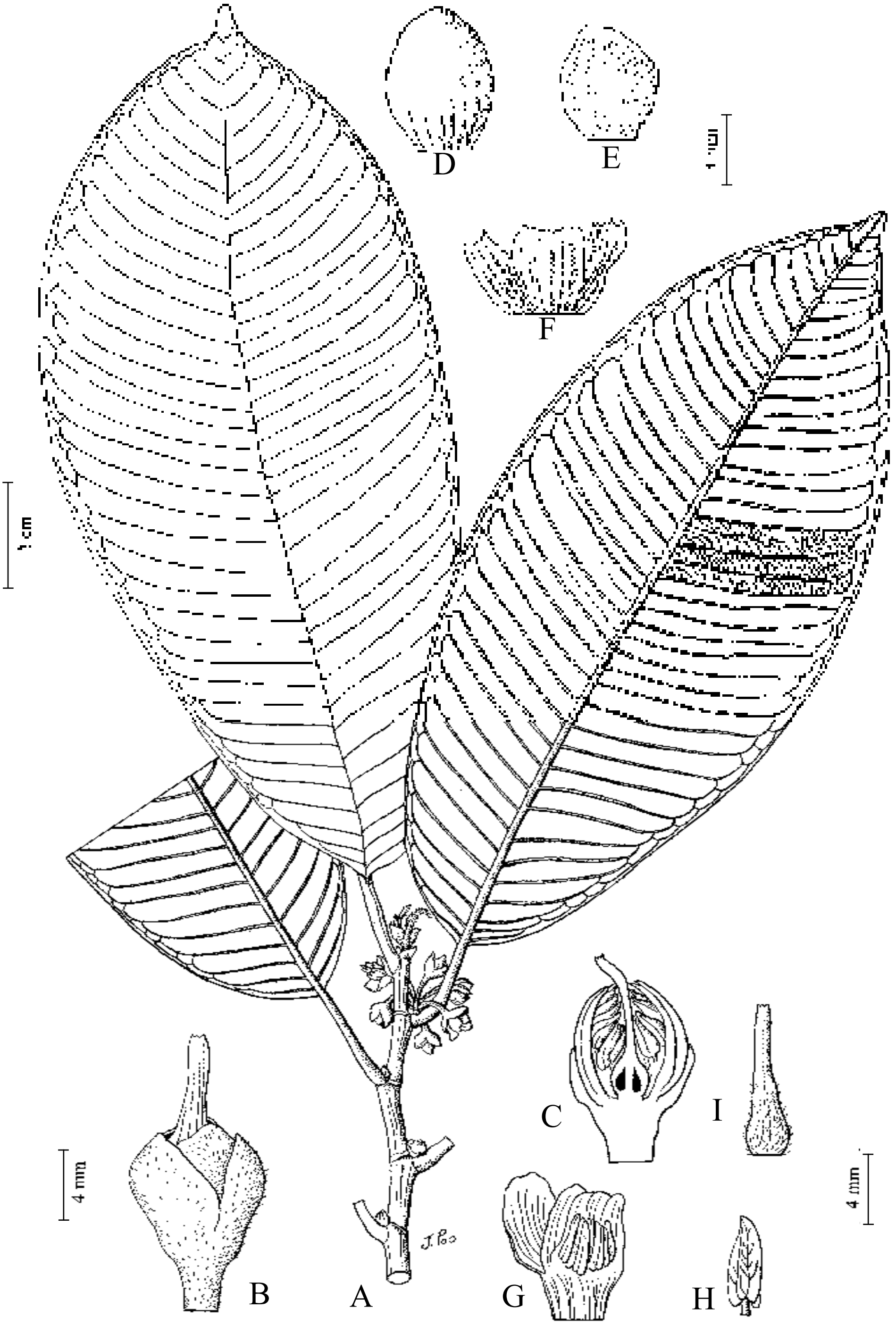

Fig. 10. *Madhuca multinervia.* A, flowering leafy twig; B, very young fruit; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petals; G, part of flower with petals and stamens; H, stamen; I, pistil. (All from *SAN 97008.*)

Tree to 20 m tall, 40 cm diameter. **Bark** pale brown with greyish mottles, smooth; inner bark pale reddish. **Sapwood** white. **Twigs** slender, 2–4 mm diameter, subangular with distinct stipular scars, *rusty-brown velvety hairy at apex*, soon glabrescent and becoming blackish. **Terminal buds** *c*. 5 mm long. **Stipules** *broadly ovate*, *c. 6 × 4 mm*, truncate, rusty-brown velvety. **Leaves** *well-spaced along ends of twigs*, chartaceous to subcoriaceous, *glabrous on both surfaces* or *covered with remnants of scattered silvery hairs*, *especially on midrib below*; oblong-elliptic, 16.5–19 × 5–12 cm, base obliquely cuneate to rounded, margin plane, apex obtuse; midrib impressed and slightly crested above, strongly prominent and rounded below; *lateral veins 28–45 pairs*, ascending at an angle of 65–80° from midrib, *arching and joining into vein-loops at 1–2 mm from leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, faint; petiole 2–4 cm long, narrowly grooved on adaxial side, rounded on abaxial side, rugose and black at base, glabrous. **Inflorescences** axillary, 3–10-flowered. **Flowers:** pedicel 1–2 cm long, slender, velvety hairy; *sepals* in two whorls of 2, free, imbricate, *orbicular*, *c. 6 mm across*, velvety hairy, inner pair thinner, crested and hairy; corolla 8-lobed, 7–10 mm long, lobes elliptic or ovate, *c*. 3.5 × 1.5 mm, apex acute, densely hairy at the throat; stamens 16–24, in two or three whorls, filaments very short, anthers sagittate, *c*. 3.5 mm long; ovary subconical, *c*. 1 mm across, 8-loculed, glabrous or sparsely hairy, style *c*. 8 mm long, glabrous. **Fruits** ellipsoid, to 2.1 × 1.2 cm, 1-seeded; *pericarp thin*, glabrous; stalk to 2 cm long. **Seeds** ellipsoid to obovoid, 1.8 × 1.1 × 0.8 cm, *obtuse at both ends*, testa glabrous; scar as long as seed, *c*. 5 mm wide.

Distribution. Endemic to Borneo. Scattered throughout the eastern part of Sabah (e.g., *SAN 88312*, *SAN 93874*, *SAN 96918*, *SAN 111764*, and *SAN 133478*).

Ecology. Usually on hillsides and ridges in primary lowland mixed dipterocarp forest.

30. **Madhuca oblongifolia** (Merr.) Merr. Fig. 11.

(Latin, *oblongus* = much longer than broad, *folium* = leaf; with oblong leaves)

Enum. Philip. Fl. Pl. 3, 3 (1923) 277; H.J. Lam *l.c.* (1925) 166, *l.c.* (1927) 447; P. Royen *l.c.* (1960) 105. **Basionym:** *Bassia oblongifolia* Merr., Philip. J. Sci. 13 (1918) 323. **Type:** *Alambra FB 27101*, the Philippines, Luzon, Camarines Province (holotype PNH†; isotype K).

Tree to 19 m tall, 35 cm diameter. **Bark** greyish brown, flaky; inner bark dull orange. **Twigs** *stout*, angular, *greyish-brown velvety hairy*, glabrescent. **Terminal buds** greyish-brown velvety hairy, *c*. 5 mm long. **Stipules** lanceolate, *c. 5 × 2 mm*, rusty-brown velvety hairy. **Leaves** *well-spaced along twigs*, *coriaceous*, glabrous above, *densely covered with rusty-brown appressed tomentum beneath*; oblong to narrowly oblong-elliptic, (15–)20–30 × (4–)6–13 cm, base cuneate, slightly decurrent, margin plane, apex short-acuminate; midrib slightly raised above, round and prominent below; *lateral veins 12–20 pairs*, *ascending at an angle of 65–80° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, distinct on both sides; *intercostal venation scalariform*, or scalariform-tessellate near leaf base, obscure above, distinct below; petiole 1.2–4.5 cm long, flat or narrowly grooved on adaxial side, thickened at base. **Inflorescences** axillary, 3–10-flowered. **Flowers:** pedicel angular, 2–4 cm long; sepals broadly ovate, *c*. 9 × 7 mm, crested, acute; corolla *c*. 8–10 mm long, 8-lobed, lobes oblong, rounded at apex; stamens 16–22, filaments *c*. 1 mm long, anthers lanceolate, *c*. 4 mm long, hairy; ovary subconical, glabrous or puberulous, *c*. 2 × 1 mm, 8–9-loculed, style subulate, *c*. 6–7 mm long,

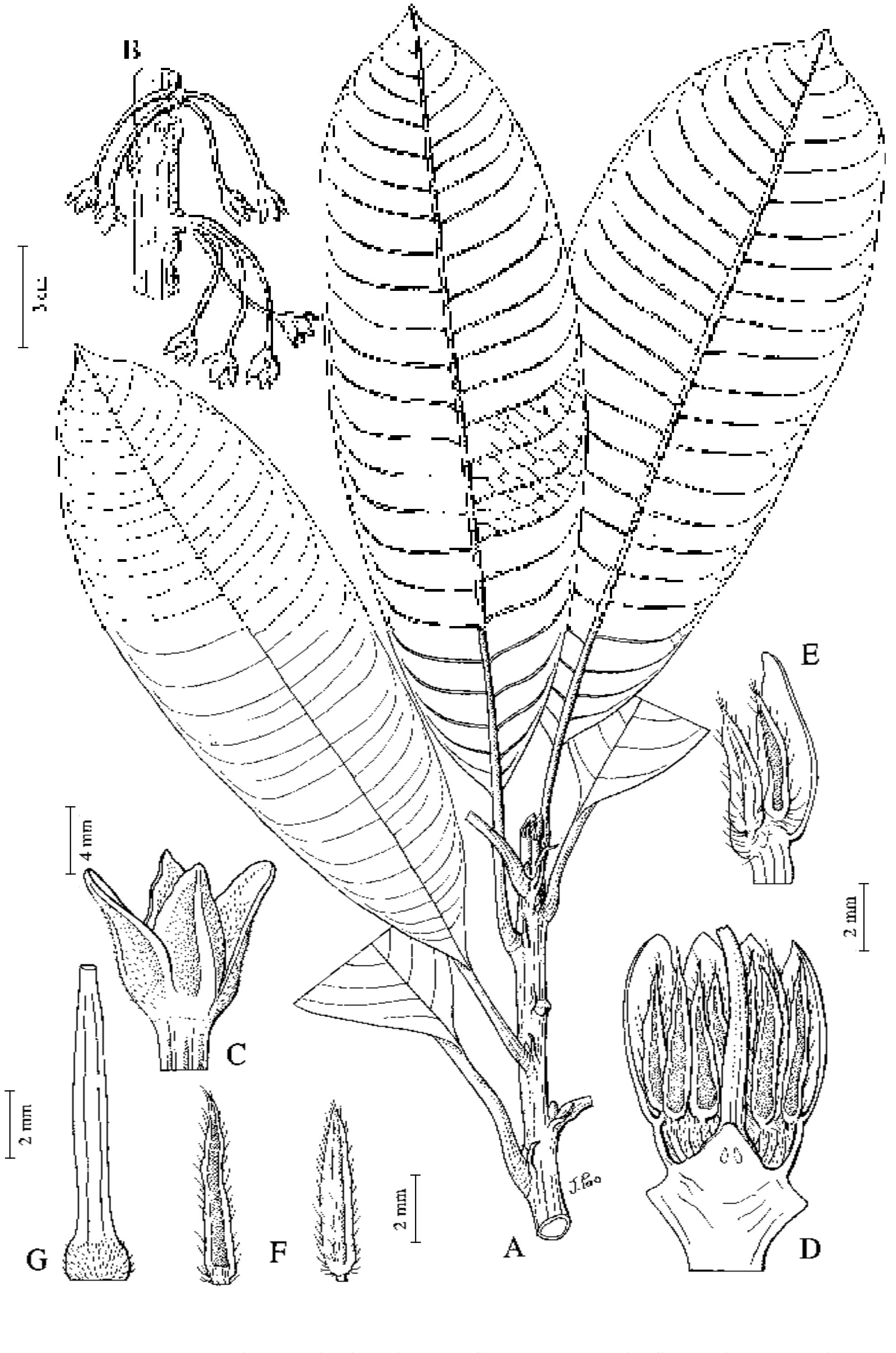

Fig. 11. *Madhuca oblongifolia*. A, leafy twig; B, inflorescences on leafless twig; C, nearly open flower; D, flower with sepals and a few petals removed; E, petal and stamens; F, stamens in different view; G, pistil. (All from *S 43468.*)

glabrous. **Fruits** ovoid-oblong, 1.8–2.4 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, sparsely hairy. **Seeds** ellipsoid, *c.* 1.5 × 0.6 cm; testa thin; scar linear.

Distribution. Borneo and the Philippines. In Borneo, known only by a few collections from Sarawak (e.g., *S 25463*, *S 32448*, *S 43468*, and *S 49168*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 250 m.

31. **Madhuca ochracea** Yii & P.Chai Fig. 12.

(Latin, *ochraceus* = pale yellowish brown; the indumentum)

Gard. Bull. Sing. 53 (2001) 350. **Type:** *Wright S 29130*, Borneo, Sarawak, Niah NP (holotype SAR; isotypes K, L, SAN, SING).

Tree to 25 m tall, 70 cm diameter. **Bark** greyish brown, scaly; inner bark dull orange. **Twigs** *angular*, *glabrous*. **Terminal buds** *c.* 5 mm long. **Stipules** *broadly ovate*, *c. 5 × 4 mm*, glabrous, persistent. **Leaves** *crowded at ends of twigs*, coriaceous, *glabrous above*, *covered with persistent pale yellowish brown tomentum below*; elliptic or elliptic-obovate, 8.5–19 × 3.5–8.2 cm, base cuneate, *margin recurved*, apex caudate or acuminate, acumen *c.* 1 cm long; midrib shallowly grooved and crested above, rounded and prominent below; *lateral veins* slender, 26–34 pairs, ascending at an angle of 80–85° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, faint and impressed above, distinct below; *intercostal venation* slender, *descending from leaf margin and parallel to lateral veins*, laxly reticulate towards leaf margin, indistinct above, faint below; petiole 2–4.8 cm long, narrowly grooved on adaxial side, thickened and rugose at base. **Inflorescences** axillary, 2–7-flowered. **Flowers:** pedicel *c.* 1.2 cm long, glabrous, angular and enlarged at apex; sepals orbicular, *c.* 6 mm across, apex rounded, velvety hairy; corolla *c.* 8 mm long, 10-lobed, lobes obovate, *c.* 4 × 3 mm, apex rounded and ciliate; stamens 16, filaments *c.* 2.5 mm long, anthers sagittate, *c.* 2.5 mm long; ovary subconical, *c.* 2 mm across, 6–8-loculed, velvety hairy, style *c.* 7 mm long, subangular, glabrous. **Fruits** (immature) ovoid, *c.* 1 cm across, base rounded, apex flattened and topped by stout remnant of style, pale yellowish brown hairy. **Seeds** unknown.

Vernacular name. Sarawak—*nyatoh kelabu* (Iban).

Distribution. Endemic to Borneo. Known only from Sarawak by two collections from Niah NP (*S 29130*) and Mentagai hills (*S 23100*), Marudi, Miri division.

Ecology. In primary lowland mixed dipterocarp forest on clay loam soils, at altitudes to 100 m.

32. **Madhuca palembanica** (Miq.) Forman

(of Palembang, Sumatra)

In Coode *et al.* (eds.) *l.c.* 439; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Podocarpus palembanicus* Miq., Fl. Ind. Bat., Suppl. (1861) 252 & 589. **Type:** *Teijsmann 3891*, Sumatra, Palembang, Muaradua (holotype U; isotype BO). **Synonym:** *Ganua palembanica* (Miq.) Van den Assem & Kostermans *l.c.* 482, H.J. Lam *l.c.* (1957) 512, Anderson *l.c.* 315.

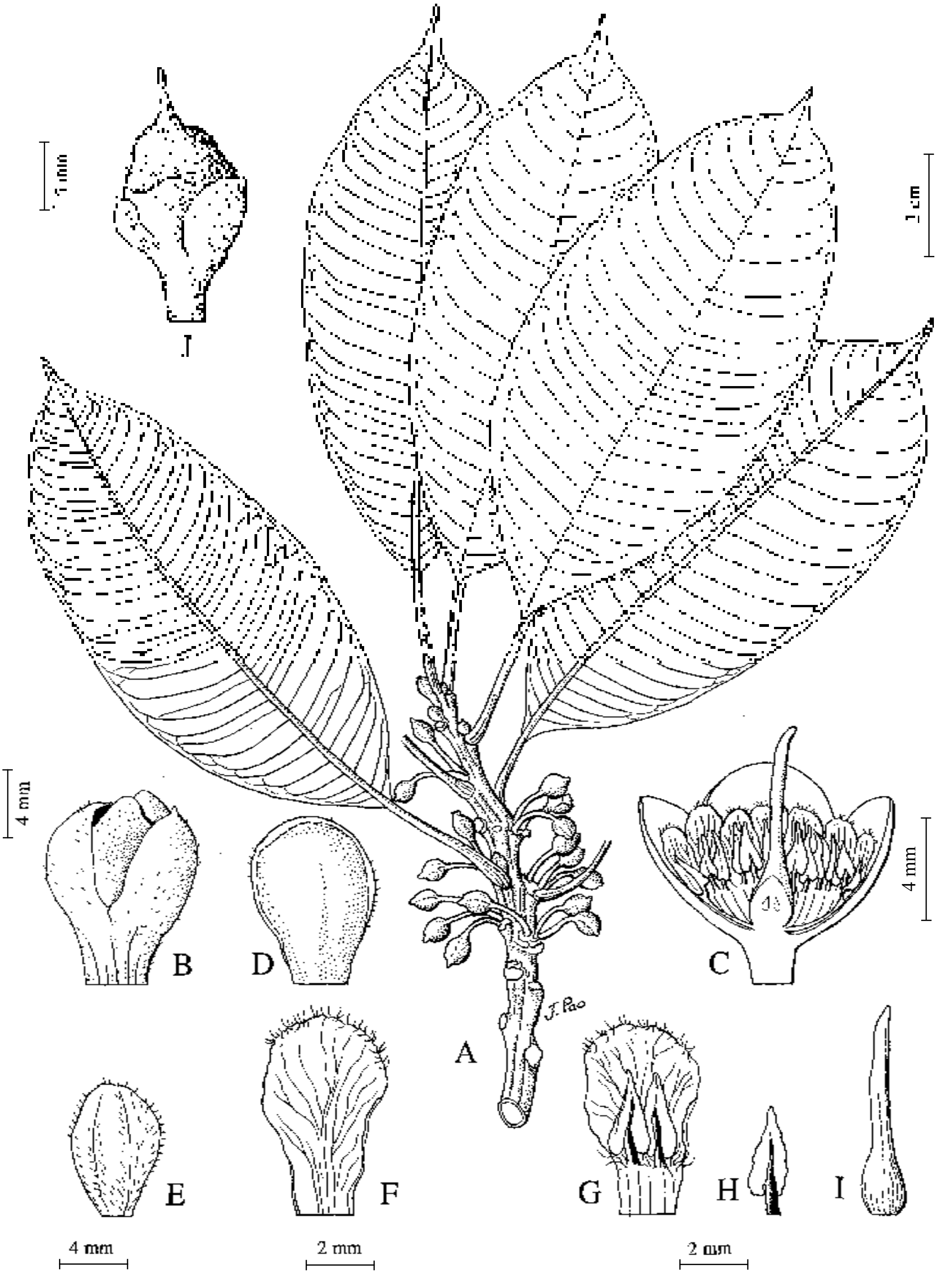

Fig. 12. *Madhuca ochracea*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petal; G, petal and stamens; H, stamen; I, pistil; J, young fruit. (A–I from *S 29130*, J from *S 23100*.)

Tree to 30 m tall, 45 cm diameter. **Bark** greyish brown or brown, scaly; inner bark dull orange. **Twigs** slender, subangular, rusty-brown hairy, glabrescent. **Terminal buds** 1–2 mm long, rusty-brown velvety hairy. **Stipules** filiform, 1–1.5 cm long, rusty-brown velvety hairy. **Leaves** *well-spaced along twigs*, chartaceous, glabrous on both surfaces; young leaves linear, *mature leaves elliptic-lanceolate*, *11–17 × 1.5–5 cm*, base cuneate and decurrent, margin plane, apex acuminate, acumen *c.* 1 cm long; midrib narrowly grooved and finely crested above, round and prominent below; *lateral veins 15–23 pairs*, *ascending at an angle of c. 80° from midrib*, *arching and joining to form a smooth intramarginal vein*, obscure above, distinct below; *intercostal venation descending from leaf margin and parallel to lateral veins*, parallel-reticulate toward intramarginal veins, obscure above, prominent below; petiole slender, 3–4 cm long, narrowly grooved on adaxial side, round on abaxial side, thickened, rugulose and blackish at base. **Inflorescences** and **flowers** unknown. Infructescences axillary. **Fruits** in fascicles of 1–4, ovoid-globose, *c.* 1.5 × 1.2 cm (immature), pubescent, 1–2-seeded; pericarp thin, woody; stalk 1.2–1.7 cm long, terete and enlarged at distal part, glabrous. **Seeds** (immature) ellipsoid, 0.8 × 0.4–0.6 cm; scar linear.

Vernacular name. Sarawak—*nyatoh tangkai panjang* (Iban).

Distribution. Sumatra and Borneo. In Borneo, uncommon and known by a few collections from Sarawak (e.g., *S 28990*, *S 37490* and *S 40527*) and Brunei.

Ecology. Usually along ridges in hill mixed dipterocarp forest, at 500–800 m altitude.

33. **Madhuca pallida** (Burck) Baehni

(Latin, *pallidus* = pale in colour; the leaves)

Boissiera 11 (1965) 36; Pennington *l.c.* 158; Kessler & Sidiyasa *l.c.* 214. **Basionym:** *Bassia pallida* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 44. **Type:** *Burck s.n.* (= *RHL Sheet Nos. 908225* and *908226*), Sumatra, Mt. Singgalang (holotype L). **Synonym:** *Illipe pallida* (Burck) Engl. *l.c.* 509; *Ganua pallida* (Burck) H.J.Lam *l.c.* (1925) 127, *l.c.* (1927) 427, *l.c.* (1957) 512, Van den Assem *l.c.* 377, Van den Assem & Kostermans *l.c.* 481, Anderson *l.c.* 315.

Tree to 16 m tall, 30 cm diameter, with low buttresses. **Bark** dark brown, smooth with vertical rows of reddish brown lenticels; inner bark pinkish, corky, fibrous or laminated. **Twigs** *angular* or *ridged*, *glabrous*. **Terminal buds** *c.* 10 × 3 mm, glabrous, with distinct narrow triangular bud-scales. **Stipules** *subulate*, *6 × 1–2 mm*, persistent at base of petioles of uppermost leaves. **Leaves** *in dense clusters of 6–10 on nodes*; *chartaceous* to *subcoriaceous*, glabrous on both surfaces; obovate or oblanceolate, 14–28 × 4–8 cm, *base cuneate* to *abruptly truncate* or *subcordate and slightly oblique*, margin plane, apex acute to acuminate; midrib impressed above, broadly rounded and prominent below; *lateral veins* 10–15 pairs, *ascending at an angle of 70–80° from midrib*, *arching and joining to form intramarginal vein-loops*, *prominent on both sides*; *intercostal venation distinctly reticulate*, occasionally with a few veins descending from leaf margin and parallel to lateral veins, prominent on both sides; petiole stout, rugose, to 0.5 cm long. **Inflorescences** in axils of leaf scars, densely crowded below leafy parts of twigs, 4–8-flowered. **Flowers:** pedicel 1.5–2 cm long, sparsely hairy; sepals broadly ovate, 4–7 mm long, hairy; corolla bright yellowish green, lobes 8, lanceolate, *c.* 10 mm long, whitish at tips; stamens 16, in two whorls; ovary ovoid, 8-loculed, hairy; style subulate. **Fruits** globose, 1–2-seeded; pericarp thin, appressed tomentose. **Seeds** ellipsoid.

Vernacular name. Kalimantan—*majang ketapang* (Malay).

Distribution. Sumatra and Borneo. In Sabah and Sarawak, uncommon (e.g., *SAN 16238*, *SAN 35097*, *SAN 76055*, *SAN 100817*, and *S 226*). Also recorded from Brunei and Kalimantan.

Ecology. Lowland mixed dipterocarp forest, at altitudes to 300 m.

34. **Madhuca primoplagensis** Vink Fig. 13.

(Latin, *primo-* = first; *plaga* = region; occurring only in the First Division of Sarawak)

Blumea 46 (2001) 195. **Type:** *Dania S 41015*, Borneo, Sarawak, Sabal FR, 74th mile Kuching-Simenggand Road (holotype L; isotypes K, KEP, SAN, SAR).

Tree or treelet to 20 m tall, 35 cm diameter. **Bark** dark brown, smooth; inner bark reddish brown. **Twigs** stout, *with rounded ribs*, densely rusty-brown woolly-hairy. **Terminal buds** to 12 mm long, woolly hairy. **Stipules** *ovate-lanceolate* or *triangular-lanceolate*, *12–16 × 3–8 mm*, acute, woolly hairy. **Leaves** *crowded at ends of twigs* or *spirally arranged and well-spaced along apical part of twigs*, *coriaceous*, *glabrous above* except for midrib, *sparsely yellowish-brown woolly-tomentose below*; obovate or elliptic, *15–40 × 7–18 cm*, base broadly cuneate, slightly oblique, margin plane, apex broadly rounded or acuminate with a blunt tip; midrib grooved and broadly crested above, rounded and prominent below; *lateral veins* 16–30 pairs, ascending at an angle of 55–70° from midrib, *distinctly arching and joining to form intramarginal vein-loops*, impressed above, prominent below; *intercostal venation scalariform*, impressed above, prominent and rusty-brown tomentose below; *petiole 2–4 cm long*, flat and keeled on adaxial side, densely woolly-tomentose. **Inflorescences** axillary or in axils of leaf scars, 3–7(–13)-flowered. **Flowers:** pedicel stout, angular, 0.5–1.7 cm long, woolly tomentose; sepals oblanceolate, 6–8 × 4–5 mm, subacute, strongly keeled, densely woolly-tomentose; corolla 8–9 mm long, 8-lobed, lobes lanceolate, obtuse; stamens 16–18, filaments *c*. 4 mm long, subulate, anthers *c*. 4 mm long, lanceolate; ovary ovoid, *c*. 2 mm across, 8–11-loculed, hairy, style 12–20 mm long, glabrous. **Fruits** ellipsoid, 2–3 × 1.4–1.6 cm, 1-seeded, rounded at both ends; pericarp fleshy, densely and persistently covered with yellowish-brown tomentum. **Seeds** ellipsoid, 1.6–1.8 × 0.8–1.1 cm, pointed at both ends; testa thin, glabrous; scar broadly linear, *c*. 15 × 5 mm.

Vernacular name. Sarawak—*nyatoh daun besar* (Malay and Iban).

Distribution. Endemic to Borneo. Known only from the First Division of Sarawak by a few collections (e.g., *S 41015*, *S 41119*, *S 42991*, and *S 69808*).

Ecology. In lowland *kerangas* and mixed dipterocarp forests on hill slopes, at altitudes to 300 m.

35. **Madhuca prolixa** (Pierre *ex* Dubard) Yii & P.Chai

(Latin, *prolixus* = expanded; the inflorescences)

Gard. Bull. Sing. 53 (2001) 345. **Basionym:** *Ganua prolixa* Pierre *ex* Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 409, Merrill *l.c.* (1921) 478, H.J. Lam *l.c.* (1925) 130, *l.c.* (1927) 427, *l.c.* (1957) 513, Masamune

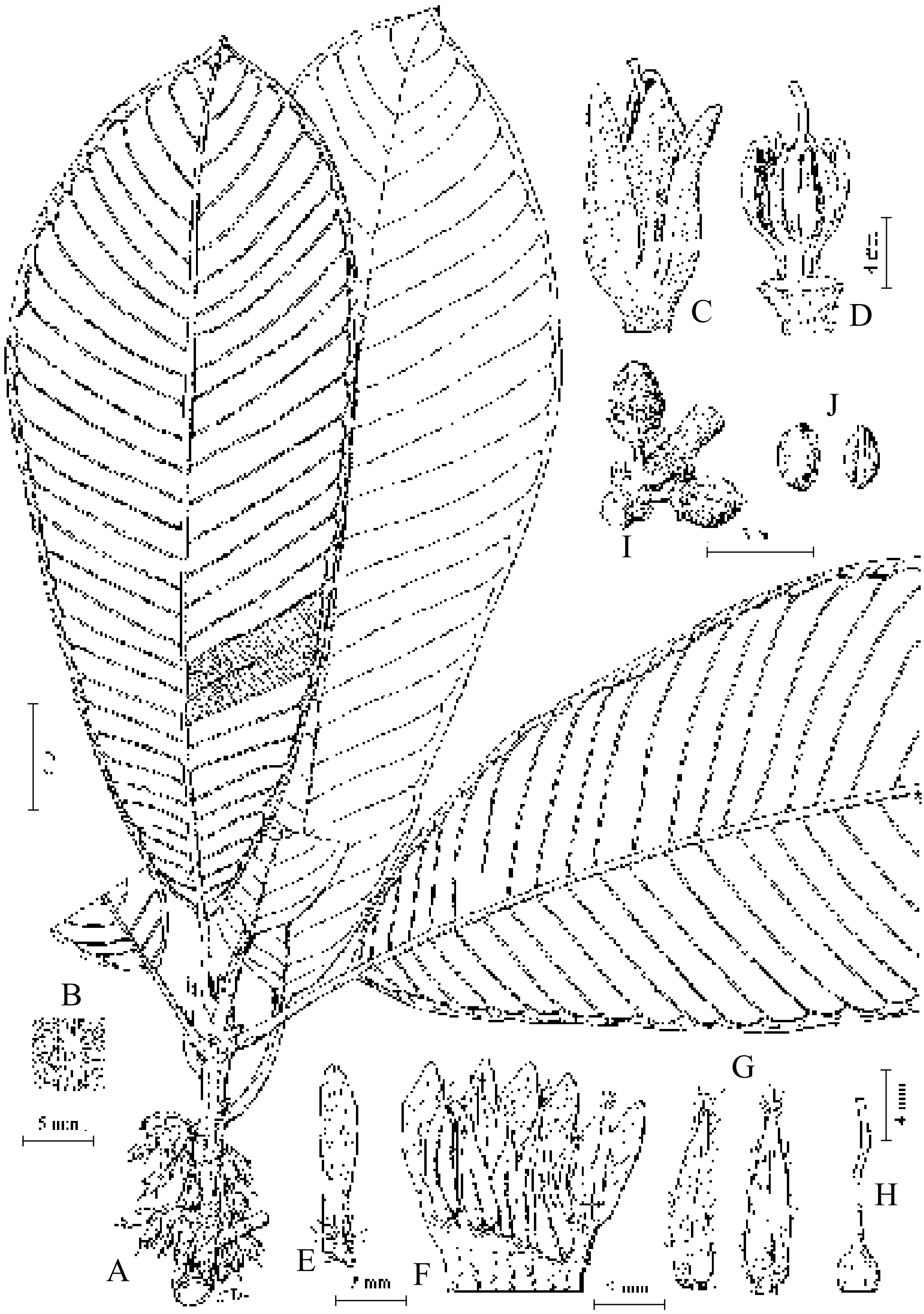

Fig. 13. *Madhuca primoplagensis*. A, flowering leafy twig; B, details of midrib and venation on lower leaf surface; C, flower bud; D, flower bud with sepals and petals removed; E, petal; F, petals and stamens; G, stamens in front and back views; H, pistil; I, infructescence; J, seeds in different views. (A–H from *S 41015*, I–J from *S 41119*.)

l.c. 589, Van den Assem *l.c.* 375, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 318. **Type:** *Beccari PB 2446*, Borneo, Sarawak, Kuching (holotype FI; isotype L).

Tree to 10 m tall, 15 cm diameter. **Bark** greyish brown, smooth; inner bark dull orange. **Twigs** stout, *terete*, *densely greyish tomentose all over*, glabrescent. **Terminal buds** *to 10 mm long*. **Stipules** *narrowly triangular*, *c. 3 × 2 mm*, caducous, greyish velvety hairy. **Leaves** *crowded at ends of twigs*, chartaceous, *glabrous on both surfaces*; *narrowly obovate*, *16–24 × 6–9 cm*, base cuneate and decurrent; *margins plane*, apex acuminate, acumen *c.* 1 cm long with an obtuse tip; midrib flat or raised above, stout and prominent below; *lateral veins 15–20 pairs*, *ascending at an angle of 80–85° from midrib*, *arching and joined by thickened intercostal veins to form intramarginal vein-loops near leaf margin*, prominent on both sides; *intercostal venation reticulate-tessellate*, with a few veins descending from leaf margin and parallel to lateral veins, prominent on both sides; *petiole* stout, *2–3 cm long*, flat or grooved on adaxial side, thickened, rugose and greyish at base. **Inflorescences** axillary, rarely in axils of leaf scars, 5–8-flowered. **Flowers:** pedicel stout, densely greyish woolly-tomentose; 1.3–1.8 cm long, terete and enlarged at apex; *sepals oblong-ovate*, 10–12 × 8–10 mm, apex acute; corolla *c.* 12 mm long, *lobes 12*, oblanceolate; *stamens 24*, filaments *c.* 2 mm long, hairy, anthers oblong-ovoid, *c.* 3 mm long, densely villous; ovary subconical, *c.* 3 × 2 mm, hirsute, style *c.* 7 mm long, glabrous. **Fruits** *subglobose*, *c. 2 × 1.7 cm*, 1-seeded; *pericarp thin*, *smooth*, yellowish-grey tomentose. **Seeds** ellipsoid, 1.5 × 0.3–0.5 cm, acute at both ends; scar *c.* 15 × 3 mm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, scattered throughout Sarawak (e.g., *S 4099*, *S 18771*, *S 25258*, and *S 29249*) and Brunei (e.g., *BRUN 2476* and *BRUN 3317*).

Ecology. In primary lowland mixed dipterocarp forest, at altitudes to 200 m.

36. **Madhuca pubicalyx** Ridl.

(Latin, *pubicalyx* = with soft-hairy calyx)

Kew Bull. (1934) 121; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 35; Burgess *l.c.* 449; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 320; Pennington *l.c.* 158; Coode *et al.* (eds.) *l.c.* 306. **Type:** *Creagh s.n.*, Borneo, Sabah (holotype K).

Tree to 25 m tall, 30 cm diameter. **Bark** greyish brown to brown, smooth to finely fissured; inner bark reddish brown. **Twigs** terete or subangular, *woolly pubescent*, glabrescent. **Terminal buds** to 1.5 cm long. **Stipules** triangular or ovate, *7–12 × 3–7 mm*, acuminate, crested, woolly puberulous outside. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous on both surfaces or greyish velvety hairy on midrib above and on whole surface below; elliptic-obovate or elliptic, rarely oblanceolate, 15–30 × 4.5–12 cm, base attenuate or cuneate and distinctly decurrent, margin plane, apex acuminate with obtuse tip; midrib impressed and narrowly crested above, rounded and prominent below; *lateral veins* 13–19 pairs, ascending at an angle of 45–55° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *scalariform*, distinct on both sides; petiole stout, (2–)3.5–6.5 cm long, narrowly grooved on adaxial side, slightly thickened at base, glabrous on upper half, greyish puberulous on lower half. **Inflorescences** axillary or in axils of leaf scars, 2–8-flowered. **Flowers:** pedicel slender, angular, 2.5–5 cm long, greyish puberulous; sepals ovate-orbicular, 7–9.5 mm across, greyish puberulous; corolla 10–16 mm long, lobes 8–9, lanceolate; stamens 18–24, in two whorls, filaments subulate, *c.* 10 mm long, rusty-brown hairy, anthers oblong, 3–6.5 mm long; ovary obconical, 8–11-loculed, yellowish puberulous, style 10–17 mm long. **Fruits** ellipsoid-obovoid, 2–2.6 × 1.2–1.8 cm, 1-seeded, obtuse at both ends; pericarp thick, velvety hairy. **Seeds** flattened ellipsoid, 2.1 × 0.6–0.9 cm, acute at both ends; testa thin, glabrous; scar linear, 19 × 2 mm.

Vernacular name. Sabah—*nyatoh* (Kedayan).

Distribution. Endemic to Borneo. Common in Sabah (e.g., *SAN 15422*, *SAN 24734*, *SAN 53556*, *SAN 97126*, and *SAN 122759*), uncommon in Sarawak (e.g., *S 23017*). Also occurs in Brunei (e.g., *Dransfield JD 6879*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

37. **Madhuca rufa** (King & Gamble) P.Royen

(Latin, *rufus* = reddish; the indumentum)

Blumea 10 (1960) 55; Ng *l.c.* 409; Turner *l.c.* 464. **Basionym:** *Isonandra rufa* King & Gamble *l.c.* 166, Ridley *l.c.* (1923) 261, H.J. Lam *l.c.* (1925) 109, *l.c.* (1927) 421. **Type:** *King's Collector 4550*, Peninsular Malaysia, Perak, Gopeng (holotype CAL; isotype SING).

Tree to 6 m tall, 8 cm diameter. **Bark** greenish, smooth; inner bark brown. **Twigs** slender, *ridged*, *densely reddish-brown woolly hairy*. **Terminal buds** *c.* 4 mm long, reddish-brown woolly hairy. **Stipules** *lanceolate, c. 4 × 1 mm*, reddish-brown woolly hairy. **Leaves** *well-spaced along twigs*, *coriaceous*, upper surface glabrous, *lower surface glabrous except for the reddish-brown hairy midribs and lateral veins*; elliptic, 7–15 × 3–5 cm, base broadly cuneate and decurrent, margin plane, apex acuminate, acumen to 1.5 cm long, with sharp tip; midrib narrowly crested above, rounded and prominent below; *lateral veins 9–12 pairs*, *ascending at an angle of 70–75° from midrib*, *arching and joining to form vein-loops near leaf margin*, *impressed above*, *distinct below*; *intercostal venation laxly reticulate*, obscure above, distinct below; *petiole 0.5–1 cm long*, *grooved on adaxial side,* swollen and densely woolly hairy at base, glabrescent. **Inflorescences** axillary, 3–6 flowered. **Flowers:** pedicel slender, 0.3–1 cm long, densely reddish-brown woolly hairy; sepals ovate-lanceolate, *c.* 4 × 3 mm, apex acute; corolla (in buds) *c.* 4 mm long, 7-lobed; *stamens 12*, *filaments c. 1 mm long*, anthers lanceolate, *c.* 2 mm long; *ovary discoid*, *c.* 0.5 × 1 mm, 5-loculed, *glabrous*, style filiform, 4–6 mm long, glabrous. **Fruits** *fusiform*, 1.5–1.8 × 0.6–0.8 cm, pointed at both ends, 1-seeded; pericarp thin, *glabrous.* **Seeds** unknown.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon and recorded only from around Beaufort Hills in Sabah (e.g., *SAN 28096* and *SAN 35097*).

Ecology. In lowland mixed dipterocarp forest.

38. **Madhuca sandakanensis** P.Royen

(of Sandakan, Sabah)

Blumea 10 (1960) 71. **Type:** *Wood SAN 16908*, Borneo, Sabah, Beaufort district, Pangi (holotype L; isotypes A, K, KEP, SAN, SING).

Tree to 17 m tall, 20 cm diameter. **Twigs** slender, *subangular*, pale yellowish green, *glabrous*. **Terminal buds** to 2.5 mm long. **Stipules** *lanceolate*, *c. 2 × 0.5 mm*, acute, velvety hairy, caducous. **Leaves** *well-spaced along twigs*, chartaceous to subcoriaceous, glabrous on both surfaces; obovate or elliptic-obovate, 11–23.5 × 6–8.5 cm, base cuneate and decurrent, margin plane, apex acuminate with an obtuse tip; midrib flat and narrowly crested above, prominent and rounded below; *lateral veins 6–11 pairs*, *ascending at an angle of c. 50° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *densely scalariform*, *distinct on both sides*; *petiole 1–3 cm long*, flat and narrowly crested on adaxial side, slightly thickened at base. **Inflorescences** axillary, 2–5-flowered. **Flowers:** pedicel angular, 0.8–1.2 cm long, greyish velvety hairy; sepals ovate, 5–6 × 3–5 mm, apex subobtuse, glabrous; *corolla c.* 8 mm long, 8-lobed, *lobes obovate-spathulate*, apex rounded; *stamens 12*, filaments filiform, 1–1.5 mm long, anthers oblong, *c.* 2.5 mm long; *ovary ovoid*, *c.* 3 × 1 mm, 8-loculed, *glabrous*, style stout, 7–12 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo. Scattered throughout Sabah (e.g., *SAN 16807*, *SAN 34865*, *SAN 41447*, *SAN 96705*, and *SAN 134083*) and Sarawak (e.g., *Hansen 817*).

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 500 m.

39. **Madhuca sarawahensis** (Pierre *ex* Dubard) H.J.Lam Fig. 14.

(a misspelling of Sarawak)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180 ("*sarawakensis*"), *l.c.* (1927) 462; Masumune *l.c.* 592; P. Royen *l.c.* (1960) 26; Whitmore, Tantra & Sutisna *l.c.* 321. **Basionym:** *Kakosmanthus sarawahensis* Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 198, Bull. Mus. Hist. Nat., Paris 14 (1908) 407, Merrill *l.c.* (1921) 479. **Lectotype** (P. Royen, 1960)**:** *Beccari PB 423*, Borneo, Sarawak, Kuching (hololectotype P; isolectotypes FI, L).

Tree to 25 m tall, 35 cm diameter. **Bark** greyish, smooth; inner bark dull orange. **Twigs** stout, *subangular*, *densely rusty-brown tomentose*. **Terminal buds** to 4 mm long. **Stipules** ovate-lanceolate, *c. 10 × 4 mm*, crested, rusty-brown tomentose. **Leaves** *well-spaced along twigs*, *coriaceous*, surface wrinkled, *glabrous on both surfaces except for the sparsely hairy midrib and lateral veins below*; *oblanceolate*, 16–51 × 6–15 cm, base broadly cuneate, slightly oblique and decurrent, margin plane, apex acuminate with sharp tip, or obtuse or rarely retuse; midrib impressed and broadly crested above, prominent and rounded below; *lateral veins 23–35 pairs*, *ascending at an angle of 60–70° from midrib*, *arching and joining to form vein-loops rather far from leaf margin*, *distinctly impressed above*, *prominent below*; *intercostal venation* slender, *scalariform*, prominent on both sides; *petiole 2.5–6 cm long*, *flat on adaxial side*, thickened and rugose at base. **Inflorescences** axillary, 7–10-flowered. **Flowers:** pedicel angular, 1–2 cm long, densely tomentose; *sepals ovate-lanceolate*, crested, *6–9 × 3–5 mm*, apex subacute, inner pair thinner, puberulous and ciliate at margin; *corolla c. 8 mm long*, 8–9-lobed, lobes lanceolate; *stamens 13–16*, *filaments* subulate, *c. 3 mm long*, *anthers narrowly sagittate*, *c. 4 mm long*, sparsely hairy; *ovary ovoid*, puberulous, 9-loculed, *style filiform*, *c. 3 mm long*, glabrous. **Fruits** ellipsoid, *c.* 3.2 × 1.7 cm, 1-seeded, obtuse at both ends, puberulous, glabrescent; pericarp fleshy, green with numerous white dots; stalk to 1 cm long. **Seeds** ellipsoid, 2.6 × 1–1.3 cm, pointed at both ends; testa thin, glabrous, dark brown; scar *c.* 5 mm wide.

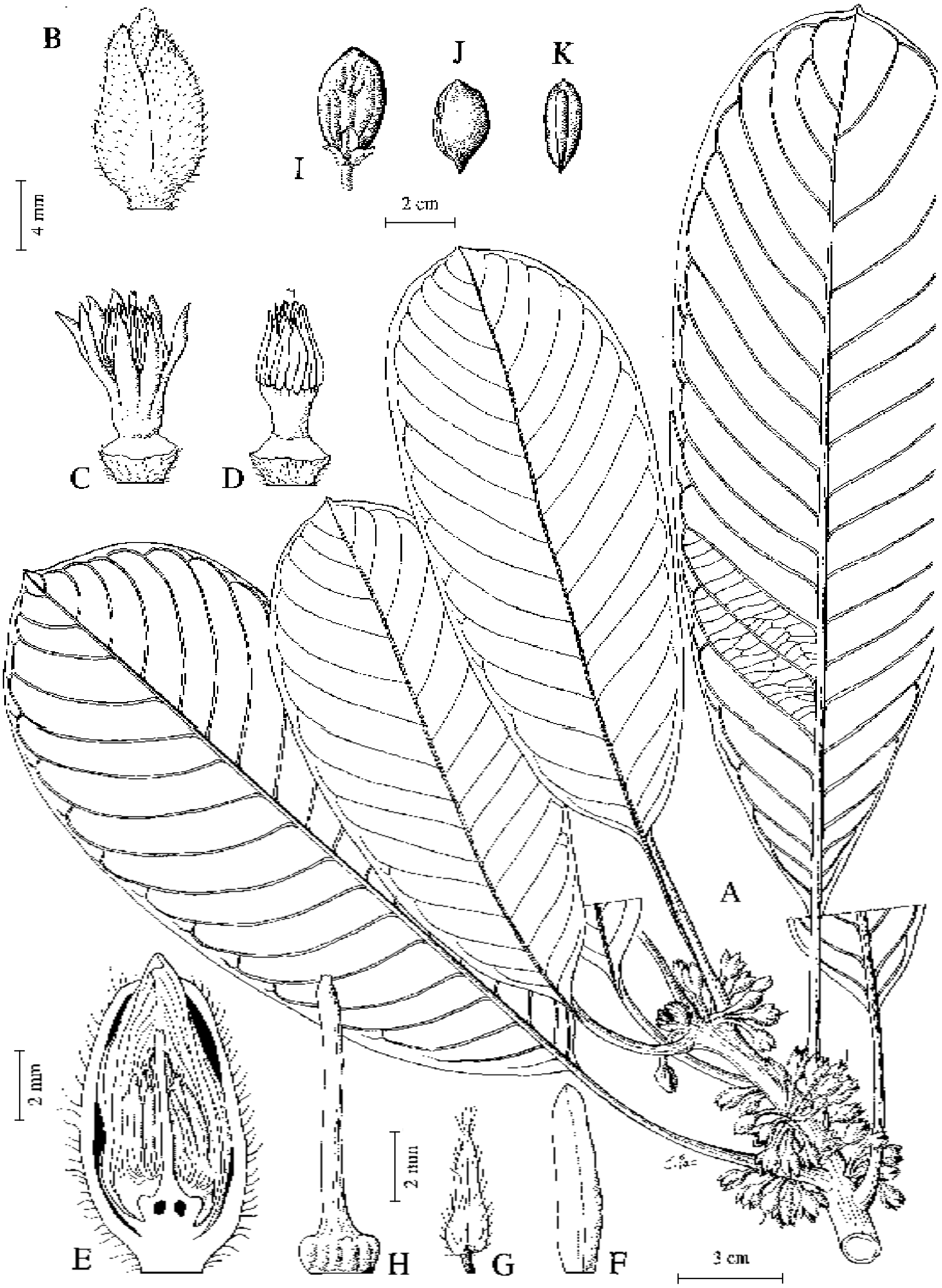

Fig. 14. *Madhuca sarawahensis.* A, flowering leafy twig; B, flower bud; C, flower bud with sepals removed; D, flower bud with sepals and petals removed; E, longitudinal section of flower bud; F, petal; G, stamen; H, pistil; I, fruit; J, side view of seed; K, adaxial view of seed. (A–H from *S 25492*, I–K from *S 29474*.)

Distribution. Endemic to Borneo. Restricted to Kuching Division in Sarawak (e.g., *S 3388*, *S 8919*, *S 9379*, *S 15777*, and *S 48220*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

40. **Madhuca sepilokensis** P.Royen

(of Sepilok, Sabah)

Blumea 10 (1960) 46. **Type:** *Wood SAN 16032*, Borneo, Sabah, Sandakan, Sepilok FR, compt. 7 (holotype L; isotypes A, K, SAN, SING).

Tree to 13 m tall, 15 cm diameter. **Twigs** slender, *subangular*, *glabrous*. **Terminal buds** to 2 mm long, greyish hairy. **Stipules** *ovate*, oblique, *c. 1.5 × 0.5 mm*, greyish hairy. **Leaves** *well-spaced along twigs*, chartaceous, glabrous on both surfaces, drying greenish brown; obovate, 19–27 × 6–10 cm, base narrowly cuneate and decurrent, margin plane, apex acuminate with obtuse tip; midrib flat or round above, round and prominent below; *lateral veins 9–13 pairs*, *ascending at an angle of 45–50° from midrib*, *diminishing and becoming inconpicuous toward leaf margin*, distinct on both sides; *intercostal venation* slender, *densely scalariform*, *faint above*, *distinct below*; *petiole 3–3.5 cm long*, flat on adaxial side, thickened at base. **Inflorescences** axillary, 3–6-flowered. **Flowers:** pedicel slender, angular, 0.9–1.3 cm long, sparsely greyish velvety-hairy; sepals ovate-lanceolate, 4–5 × 3–4 mm, apex obtuse with tufts of black hairs; *corolla c.* 9 mm long, 8-lobed, *lobes oblong*, apex obtuse; *stamens 18*, filaments subulate, *c.* 1 mm long, anthers oblong, *c.* 3 mm long; *ovary ovoid*, *c.* 2 × 1 mm, 8-loculed, *glabrous*, styles filiform, *c.* 12 mm long, glabrous. **Fruits** ellipsoid, *c.* 2.1 × 1 cm, 1-seeded, acute at both ends; pericarp thin, glabrous. **Seeds** ellipsoid, 1.6 × 0.6–1 cm, acute at both ends, testa thin, glabrous; scar *c.* 1.5 mm wide.

Distribution. Endemic to Borneo and confined to Sandakan district in Sabah (e.g., *SAN 17725*, *SAN 21714*, *SAN 58685*, *SAN 63058*, and *SAN 99301*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 100 m.

41. **Madhuca sericea** (Miq.) H.J.Lam

(Latin, *sericeus* = silky with long straight closely pressed glossy hairs; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 163 & 264, *l.c.* (1927) 446; Ridley *l.c.* (1925) 319; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 70; J. Sinclair, Gard. Bull. Sing. 22 (1965) 220; Ng *l.c.* 410; Whitmore, Tantra & Sutisna *l.c.* 321; PROSEA *l.c.* 293; Kessler & Sidiyasa *l.c.* 214; Turner *l.c.* 465; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Payena sericea* Miq., Fl. Ind. Bat. 2 (1859) 1039. **Type:** *Horsfield s.n.*, Sumatra, Bangka (holotype BO; isotype K). **Synonyms:** *Bassia argentea auct. non* de Vriese: C.B.Clarke *in* Hooker *f. l.c.* 545, *nom. illeg.*, King & Gamble *l.c.* 184, Ridley *l.c.* (1923) 270; *Kakosmanthus argenteus* (C.B.Clarke) Pierre *ex* Dubard, Rev. Gen. Bot. (1908) 198; *P. ridleyi* Gaud., Bull. Soc. Bot. Fr. 65 (1918) 56, A. Bruggen, Blumea 9 (1958) 133; *M. sericea* var. *ridleyi* (Gaud.) Ng *l.c.* 410, PROSEA *l.c.* 293, Turner *l.c.* 464; *B. sericea* (Miq.) King, J. Bot. 63, Suppl. (1925) 61.

Tree to 33 m tall, 60 cm diameter. **Bark** vertically cracked, firm, greyish brown; inner bark red, with little white sap. **Twigs** *slender*, subangular, *persistently greyish sericeous*. **Terminal**

buds 2–4 mm long, sericeous. **Stipules** *minute*, sericeous, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, glabrous above, *golden* or *silvery-brown sericeous below*; elliptic, 6.5–18.5 × 3.5–8.7 cm, base cuneate and slightly oblique, margin plane, *apex acuminate*; midrib grooved and narrowly crested above, prominent below; *lateral veins 10–14 pairs*, *ascending at an angle of c. 60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, *prominent on both sides*; *intercostal venation* slender, *scalariform*, distinct on both sides; *petiole 1.3–4.5 cm long*, flat or shallowly furrowed on adaxial side, thickened at base. **Inflorescences** axillary, *3–7-flowered*. **Flowers:** pedicel subangular, 0.7–1.4 cm long, golden sericeous; sepals broadly ovate, *c.* 5 × 4 mm, apex acute and ciliate with tufts of black hairs; corolla *c.* 6 mm long, 8–9-lobed, lobes spathulate, *c.* 4 × 1.5 mm, glabrous except for the sparsely hairy throat; stamens 10–16, in two whorls, filaments 1–1.5 mm long, *anthers sagitatte*, *c. 2.5 mm long*; *ovary ovoid*, *c.* 1 mm across, 8-loculed, glabrous, style filiform, 7–9 mm long, glabrous. **Fruits** ellipsoid, 2–3.5 × 1–1.5 cm, 1-seeded, acute at both ends; pericarp woody, greyish sericeous when young, glabrous when mature. **Seeds** ellipsoid, 1–1.5 × 0.5 cm; scar *c.* 4 mm wide.

Distribution. Sumatra (Lingga, Enggano and Bangka), Peninsular Malaysia, Singapore, and Borneo. Scattered throughout Sabah (e.g., *SAN 16647* and *SAN 16787*) and Sarawak (e.g., *S 25983*). Also known from Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 1000 m.

42. **Madhuca sessilis** (King & Gamble) Baehni

(Latin, *sessilis* = without stalk; the leaves)

Boissiera 11 (1965) 36; Turner *l.c.* 465; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Payena sessilis* King & Gamble *l.c.* 174; Ridley *l.c.* (1923) 265. **Type:** *Ridley 5076*, Singapore (holotype SING). **Synonym:** *Ganua sessilis* (King & Gamble) H.J.Lam *l.c.* (1925) 120, *l.c.* (1927) 424, Van den Assem *l.c.* 387, Ng *l.c.* 399, Whitmore, Tantra & Sutisna *l.c.* 318.

Tree to 18 m tall, 35 cm diameter. **Bark** greyish brown, shallowly fissured or scaly. **Twigs** slender, subangular, *glabrous*. Bud-scales conspicuous, lanceolate to narrowly triangular, *c.* 4.5 × 2 mm, glabrous. **Stipules** *absent*. **Leaves** *crowded at end of twigs*, subcoriaceous, *glabrous on both surfaces*, on drying dark green above, paler below; spathulate, rarely obovate, 2.5–5.5 × 1.5–2.5 cm, base narrowly cuneate, margin plane, apex blunt or rounded; midrib raised on both sides; *lateral veins* 7–9 pairs, ascending at an angle of 70–80° from midrib, *arching and joining to form intramarginal vein-loops*, obscure on both sides; *intercostal venation laxly reticulate*, with a few veins descending from leaf margin and parallel to lateral veins; *petiole very short*, *leaves almost sessile*. **Inflorescences** axillary or in axils of leaf scars, 2–3-flowered. Fully developed flowers unknown; pedicel 0.8–1.2 cm long, slightly enlarged at both ends. **Fruits** globose, *c.* 1 cm diameter, 1-seeded, flattened at both ends, with persistent style remnant; pericarp thin, purplish green, glabrous. **Seeds** (immature) oblong, *c.* 7 mm long.

Distribution. Sumatra (Biliton), Singapore and Borneo. In Sarawak, very rare, represented by two collections (*S 37849* and *S 49951*) from the lower slopes of G. Pueh, Kuching Division. Also occurs in Kalimantan.

Ecology. In mixed dipterocarp forest on red-yellow igneous soils.

43. **Madhuca silamensis** Yii & P.Chai Fig. 15.

(of Mt. Silam, Sabah)

Gard. Bull. Sing. 53 (2001) 354. **Type:** *Mujin SAN 37849*, Borneo, Sabah, Mt. Silam (holotype SAR; isotype SAN).

Tree to 9 m tall, 15 cm diameter. **Bark** shallowly fissured or scaly, greyish brown; inner bark brittle, with white latex. **Twigs** *stout*, *subangular*, glabrous. **Terminal buds** to 8 mm long. **Stipules** *triangular*, *c. 4 × 4 mm*, crested, glabrous. **Leaves** *well-spaced along twigs*, *thickly coriaceous*, *silvery brown tomentose on both surfaces*; elliptic to oblong-elliptic, 16–25 × 6–8 cm, base narrowly cuneate, margin plane, apex blunt or rounded; midrib raised on both sides, stronger below; *lateral veins 15–19 pairs*, *ascending at an angle of 70–80° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, distinctly raised on both sides; *intercostal venation laxly reticulate*; *petiole 3–4 cm long*, *grooved on adaxial side*, thickened at base, glabrous. **Inflorescences** axillary, 2–3-flowered. **Flowers:** pedicel 1–1.5 cm long, angular and slightly enlarged at both ends; sepals broadly ovate, *c.* 6 × 4 mm, rusty-brown tomentose (mature flowers unknown). **Fruits** unknown.

Distribution. Endemic to Sabah and known only from the type collection from Mt. Silam, Lahad Datu district and *SAN 51742* from Bt. Tawai, Kinabatangan district.

Ecology. In forest on ultrabasic soils, at altitude *c.* 850 m.

44. **Madhuca spectabilis** P.Royen

(Latin, *spectabilis* = spectacular, looking good; the impressive appearance of the tree)

Blumea 10 (1960) 24; Pennington *l.c.* 159; Kessler & Sidiyasa *l.c.* 214. **Type:** *NIFS bb 13911*, Borneo, Kalimantan, Balikpapan (holotype L; isotypes BO, SING).

Tree to 26 m tall, 40 cm diameter. **Twigs** stout, subangular, rusty-brown tomentose, glabrescent. **Terminal buds** to 25 mm long, hairy. **Stipules** lanceolate, *c.* 15 × 5 mm, glabrous except for the ciliate margin. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous on both surfaces; *narrowly obovate*, *25–40 × 6.5–11 cm*, base narrowly cuneate, slightly decurrent, margins plane, apex long-acuminate, acumen *c.* 1.5 cm long; midrib slightly raised above, rounded and prominent below; *lateral veins* 26–30 pairs, *ascending at an angle of c. 65° from midrib*, *strongly arching and joining into a smooth intramarginal vein*; *intercostal venation* slender, *scalariform*, obscure above, distinct below; petiole 3.5–6 cm long, flat or slightly furrowed on adaxial side, rounded on abaxial side, thickened and rugose at base. **Inflorescences** on branchlets below leaves, 8–many-flowered. **Flowers:** pedicel slender, *c.* 1.5 cm long, subangular, hairy; sepals orbicular, 5–7 mm across, apex rounded; corolla *c.* 8 mm long, 8–9-lobed, lobes broadly elliptic, 5–6 × 1–2.5 mm, hairy; stamens *c.* 20, filaments *c.* 2 mm long, anthers sagitatte, *c.* 3.5 mm long; ovary discoid, *c.* 2 mm across, 8-loculed, villous, styles filiform, *c.* 10 mm long, glabrous. **Fruits** unknown.

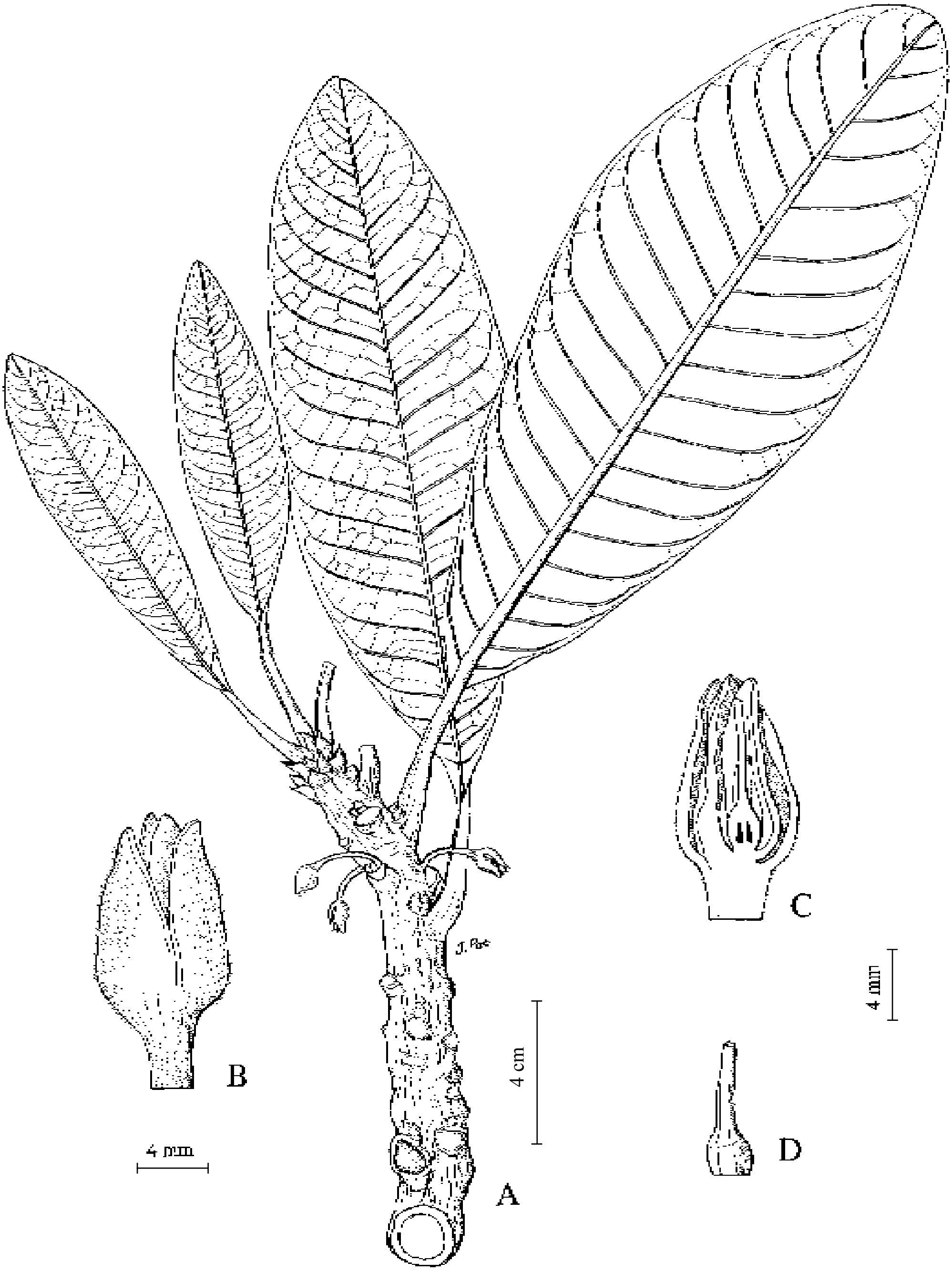

Fig. 15. *Madhuca silamensis.* A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, pistil. (All from *SAN 37849.*)

Distribution. Endemic to Borneo. Uncommon and scattered around Sandakan, Sabah (e.g., *SAN 4382* and *SAN 4775*). Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

45. **Madhuca utilis** (Ridl.) H.J.Lam

(Latin, *utilis* = useful; the timber)

In Heyne, Nutt. Pl. Ned. Ind. 2 (1927) 1231, *l.c.* (1927) 460; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 99; Ng *l.c.* 411; Whitmore, Tantra & Sutisna *l.c.* 321; Pennington *l.c.* 159; Turner *l.c.* 465. **Basionym:** *Payena utilis* Ridl., J. As. Soc. Str. Br. 79 (1918) 94, *l.c.* (1923) 265, H.J. Lam *l.c.* (1925) 150. **Type:** *Hashim CF 477*, Peninsular Malaysia, Ulu Selangor (holotype K; isotype KEP). **Synonyms:** *Madhuca stenophylla* H.J.Lam *l.c.* (1925) 179, Ridley *l.c.* (1925) 342; *Isonandra utilis* (Ridl.) Baehni *l.c.* 84.

Tree to 40 m tall, 70 cm diameter; buttresses usually steep, to 2.5 m high and 1 m wide. **Bark** greyish brown, smooth or shallowly fissured; inner bark reddish brown, laminated. **Twigs** slender, terete, sparsely rusty-brown tomentose, glabrescent. **Terminal buds** *c.* 2 mm long. **Stipules** *linear*, *c. 3 × 1 mm*, densely tomentose. **Leaves** *crowded at ends of twigs*, *membranous* to *chartaceous*, *glabrous on both surfaces*, *not waxy above*; obovate or spathulate, 5–8 × 2–3.5 cm (leaves of saplings to 18 × 6 cm), base narrowly cuneate and decurrent, margins plane, apex obtuse or rounded; midrib narrowly crested above, prominent below; *lateral veins* slender, 9–12 pairs, ascending at an angle of *c.* 60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, or rarely irregularly arching and joining into intramarginal vein-loops, obscure on both sides; *intercostal venation* slender, *reticulate*, obscure on both sides; petiole slender, less than 2 cm long, flat or broadly grooved on adaxial side, angular on abaxial side. **Inflorescences** in axils of young leaves and crowded at tips of twigs. **Flowers:** pedicel slender, angular, 0.9–1.8 cm long, silky hairy; sepals ovate-elliptic, *c.* 6 × 4 mm, silky hairy; corolla *c.* 8 mm long, 8–9-lobed, lobes oblong; stamens 10–16, filaments filiform, *c.* 5 mm long, anthers oblong; ovary globose, 8-loculed, glabrous, style 5–7 mm long, glabrous. **Fruits** ellipsoid, 3.5–5.5 × 1.5–2.5 cm, 1-seeded, rounded at apex, narrowed at base; pericarp thin, glabrous; stalk to 2.5 cm long. **Seeds** laterally compressed, ellipsoid, 3.5 × 1–1.8 cm; testa thin; scar 10–18 × 3–5 mm.

Vernacular names. Sarawak—*nyatoh batu*, *nyatoh jelutong* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, uncommon (e.g., *S 1436*, *S 14707* and *S 15992*). Also occurs in Kalimantan.

Ecology. In peat swamp and lowland wet *kerangas* forests.

Uses. Produces good quality *nyatoh* timber with decorative grains and good finishing, suitable for interior panelling, furniture and boat making.

46. **Madhuca vulpina** Vink

(Latin, *vulpinus* = resembling that of foxes; referring to the colour of the indumentum)

Blumea 46 (2001) 197. **Type:** *Sibat S 24613*, Borneo, Sarawak, Nyabau FR (holotype L; isotypes A, BO, FHO, K, MEL, SAN, SAR, SING).

Tree to 30 m tall, 45 cm diameter. **Bark** brown, flaky; inner bark reddish brown. **Twigs** slender, terete or with shallow rounded ribs, *rusty-brown velvety-hairy*, glabrescent. **Terminal buds** *c.* 3 mm long, hairy. **Stipules** lanceolate, *c. 3 × 1.5 mm*, hairy, caducous. **Leaves** mostly *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*; *oblanceolate*, *obovate* or *obovate-elliptic*, (5–)10–18 × (2–)4–5.5 cm, base cuneate, margin plane, apex acute, obtuse to acuminate with an obtuse tip; midrib prominently raised on both sides; *lateral veins* (*9–*)*15–20 pairs*, ascending at an angle of 55–75° from midrib, *arching and joined by thickened intercostal veins to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation* slender, *laxly* to *densely reticulate*, often with veins descending from leaf margin and parallel to lateral veins, obscure above, distinct below; *petiole* (*1–*)*2–3.5 cm long*, flat on adaxial side, round on abaxial side, thickened at base. **Inflorescences** axillary, *1–3*(rarely up to 8)*-flowered*. **Flowers:** pedicel slender, 0.8–1.5 cm long, densely woolly-tomentose; sepals suborbicular, 4–6 mm across; *corolla c.* 5 mm long, *lobes 8–16*, obovate or spathulate; *stamens 16–32*, *in two* or *three whorls*, filaments *c.* 1 mm long, anthers lanceolate, *c.* 1 mm long; ovary disciform to ovoid, *c.* 2 mm across, 8–10-loculed, pilose, style subulate and glabrous. **Fruits** ovoid-globose, 2–2.5 × 1–1.5 cm, 1-seeded; pericarp thin, densely yellowish tomentose. **Seeds** laterally compressed, obovoid to ellipsoid, 1.8 × 0.5–0.8 cm, rounded at both ends; testa thin and glabrous; scar linear, *c.* 18 × 1.5 mm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, confined to Kuching and Bintulu divisions in Sarawak (e.g., *S 3377*, *S 8910*, *S 12849*, *S 25376*, and *S 42108*).

Ecology. In primary *kerangas* and mixed dipterocarp forests, at altitudes below 100 m.

47. **Madhuca woodii** P.Royen

(G.H.S. Wood, 1927–1957, botanist at the Sandakan Herbarium)

Blumea 10 (1960) 36. **Type:** *Wood SAN 15215*, Borneo, Sabah, Beaufort district, Pangi (holotype L; isotypes A, BO, BRI, K, KEP, SING).

Tree to 20 m tall, 30 cm diameter. **Twigs** slender, *terete*, *glabrous*. **Terminal buds** to 3 mm long, pubescent. **Stipules** *ovate*, *c. 2 × 1 mm*, pubescent, caducous. **Leaves** *well-spaced along twigs*, chartaceous to subcoriaceous, glabrous on both surfaces, drying dark reddish brown below; elliptic or elliptic-obovate, 22–30 × 7–11 cm, base cuneate, margin plane, apex long-acuminate, acumen to 1.5 cm long; midrib shallowly grooved and broadly crested above, prominent and round below; *lateral veins 13–20 pairs*, *ascending at an angle of 40–45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, distinct on both sides; *intercostal venation* slender, *densely scalariform*, faint on both sides; petiole 2–3.5 cm long, flat on adaxial side, slightly thickened at base. **Inflorescences** axillary, 3–7-flowered. **Flowers:** pedicel angular, velvety hairy, 1.5–1.8 cm long; sepals ovate, glabrous, 4.5–6 × 3–3.5 mm, apex round; corolla *c.* 8 mm long, lobes 8, oblong, apex round; *stamens 12*, filaments subulate, anthers lanceolate; *ovary ovoid*, 2.5–3 × 2 mm, 8-loculed, *hairy*, style filiform, 10–15 mm long, glabrous. **Fruits** (immature) subconical, 1-seeded, with short style remnant, rusty-brown tomentose.

Distribution. Endemic to Borneo and restricted to Sandakan district in Sabah (e.g., *SAN 41273* and *SAN 135405*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 300 m.

7. **MIMUSOPS** L.

(Greek, *mimous* = an ape, *opsis* = look alike; inference unknown)

L.C.J. Julaihi

Sp. Pl. 1 (1753) 349; Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 661; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 199; Ridley, FMP 2 (1923) 277; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 234, *ibid.* 3, 8 (1927) 479; P. Royen, Blumea 6 (1952) 594; Backer & Bakhuizen *f.*, FJ 2 (1965) 191; Ng, TFM 1 (1972) 414; Chai, Some Ornamental & Roadside Plants of Sarawak (1984) 102; Corner, WSTM 3rd edition 2 (1988) 693; Pennington, Gen. Sapot. (1991) 120. **Synonyms:** *Imbricaria* Comm. *ex* Juss., Gen. Pl. (1789) 152; *Semicipium* Pierre, Not. Bot. Sapot. (1890) 10; *Kaukenia* Kuntze, Rev. Gen. Pl. 2 (1891) 406.

Shrubs or trees. **Stipules** often present, minute, caducous. **Leaves** spirally arranged, well-spaced along twigs or clustered at ends of twigs; blade with plane, wavy, or recurved margin; lateral veins arching and joining near leaf margin to form a smooth intramarginal vein or vein-loops; intercostal venation descending from leaf margin and parallel to lateral veins, or *reticulate*. **Inflorescences** 1–many-flowered fascicles, in axils of leaves or leaf scars. **Flowers** bisexual; *sepals 8*, *in two whorls of 4*, free, outer whorl valvate; corolla bell-shaped, hairy or glabrous, *lobes 8*, *each lobe divided to base into 3 segments*, median segments usually erect and clasping stamens, corolla tube much shorter than lobes; *stamens 8*, in a single whorl, inserted at throat of corolla tube; filaments free or partially fused to staminodes, anthers extrorse, hairy or glabrous; *staminodes 8*, well-developed, alternating with stamens, *hairy*; ovary 6–8-loculed, conoid, hairy, style subulate. **Fruit** a berry, 1–6-seeded; pericarp fleshy. **Seeds** laterally compressed; *scar small*, often circular or elliptic, *basal* or basi-ventral; cotyledons foliaceous; endosperm copious.

Distribution. About 30 species, distributed in the Old World tropics; 20 species in Africa, 15 in Madagascar, 4 in Mascarenes, 1 in Seychelles, and 1 in Asia and the Pacific Islands.

Taxonomy. *Mimusops* is closely allied to *Manilkara* Adans. but differs by having 8 sepals in two whorls of 4, 8 corolla lobes, 8 stamens and 8 well-developed staminodes. In *Manilkara*, the flowers have 6 sepals in two whorls of 3, 6 corolla lobes, 6 stamens and 6 staminodes.

Mimusops elengi L. Fig. 16.

(after a Malabar plant name)

Sp. Pl. 1 (1753) 349; King & Gamble *l.c.* 199; Ridley *l.c.* 278; H.J. Lam *l.c.* (1925) 234, *l.c.* (1927) 479; Backer & Bakhuizen *f. l.c.* 191; Ng *l.c.* 414; Corner *l.c.* 694; Pennington *l.c.* 123; Turner, Gard. Bull. Sing. 47 (1995) 465. **Type:** unknown. **Synonyms:** *Mimusops parvifolia* R.Br., Prodr. (1810) 531; *M. obtusifolia* Blume, Bijdr. Fl. Ned. Ind. (1825) 673; *M. javensis* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 63; *M. timorensis* Burck *l.c.* 63; *M. laterica* Elmer, Leafl. Philip. Bot. 8 (1915) 2816; *M. elengi* L. var. *typica* (Blume *ex* Burck) H.J.Lam *l.c.* (1925) 235 (including forma *longepedunculata*); *M. elengi* L. var. *parvifolia* (R.Br.) H.J.Lam *l.c.* (1925) 236; *M. elengi* L. var. *brevifolia* H.J.Lam *l.c.* (1925) 236.

Tree to 20 m tall and 40 cm diameter. **Bark** finely fissured, greyish brown to dark brown; inner bark soft and fibrous, pinkish. **Sapwood** pink; heartwood reddish. **Twigs** slender, 1–3 mm thick, rusty-brown pubescent. **Stipules** lanceolate, *c.* 3 × 1 mm, rusty-brown pubescent. **Leaves** evenly scattered along twigs, chartaceous; elliptic, 4.5–9 × 1.8–5.4 cm, base cuneate, margin

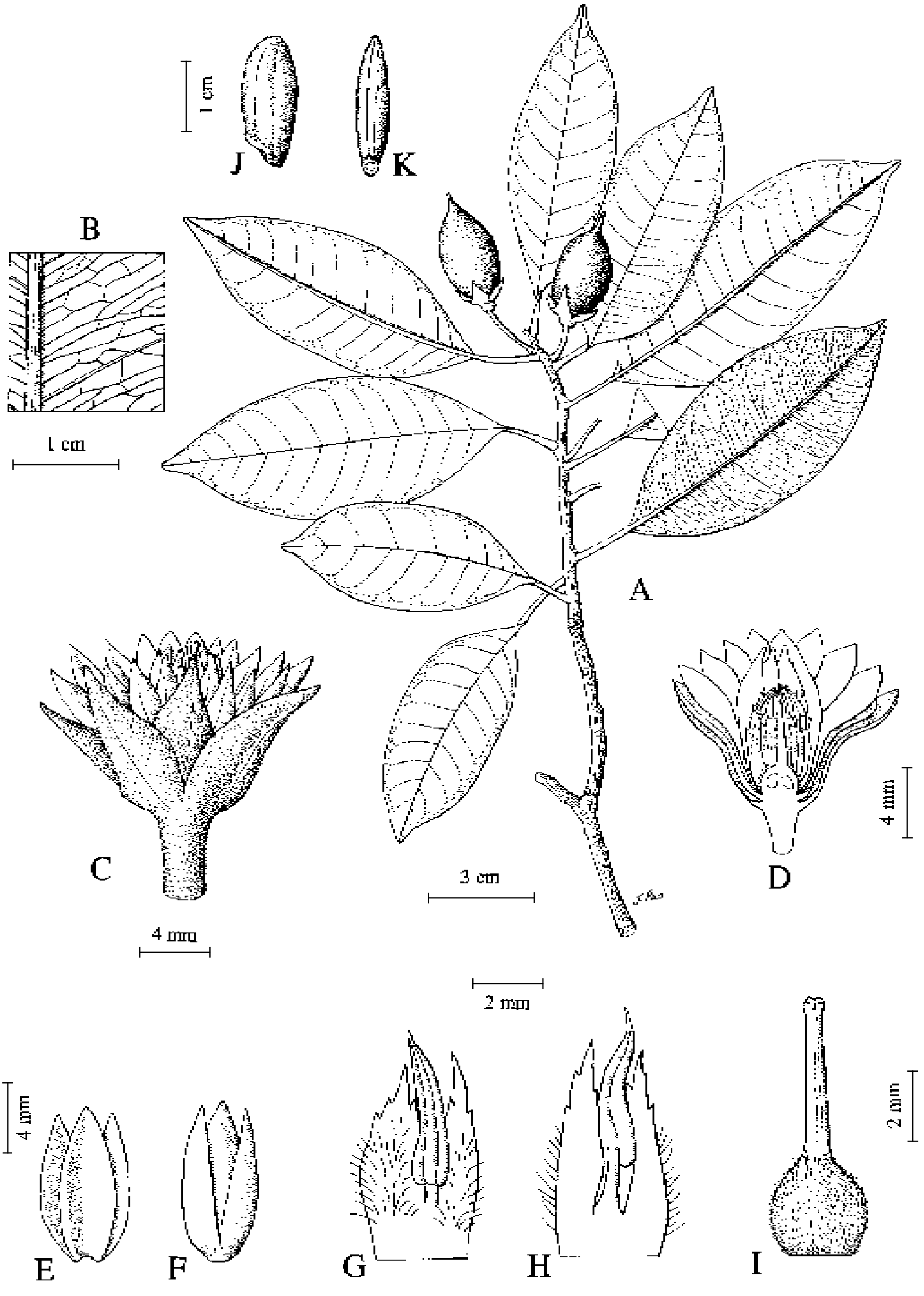

Fig. 16. *Mimusops elengi.* A, fruiting leafy twig; B, detail of leaf venation; C, open flower; D, longitudinal section of flower; E, adaxial side of petals; F, abaxial side of petals; G, frontal view of stamen; H, dorsal view of stamen; I, pistil; J, side view of seed; K, adaxial side of seed. (All from

wavy and recurved, apex short-acuminate; midrib slightly raised above, more prominent below; lateral veins 11–8 pairs, slender; petiole 0.6–2 cm long, grooved on adaxial side. **Inflorescences** axillary, 1–6-flowered. **Flowers** fragrant; pedicel 0.5–1 cm long, rusty-brown tomentose; sepals ovate-lanceolate, rusty-brown tomentose outside, glabrous within; corolla white, lobes linear lanceolate, inner lobes broader and shorter; filaments slender, *c.* 1.5 mm long, anthers sagittate; staminodes flat and hairy; ovary conoid, silky-brown tomentose, 6–8-loculed, style slender, *c.* 7 mm long. **Fruits** ovoid, *c.* 3 × 2 cm, 1–2-seeded, ripening orange; mesocarp (pulp) yellow. **Seeds** ellipsoid, *c.* 2 × 0.7 cm; scar *c.* 3 × 2 mm, basal.

Vernacular name. Sarawak—*bunga tanjong* (Malay).

Distribution. India, Sri Lanka, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Sulawesi, the Philippines, Maluku, Lesser Sunda Islands, Australia, and New Caledonia. In Borneo, scattered in littoral forest at Pulau Tiga, Beaufort and Sempurna in Sabah (e.g., *SAN 18473*, *SAN 34722*, *SAN 49140*, *SAN 84741*, and *SAN 93055*), and Semantan and Tg. Datu in Sarawak (e.g., *S 29943*, *S 32609* and *S 57560*).

Uses. *Bunga tanjong* is a popular village tree because of its fragrant flowers. It is also a good ornamental and roadside tree that adapts well in most sites. A decoction of the bark and flowers is used internally for fever and diarrhoea, and an infusion of the root is for treating sore throat. The leaves are boiled and applied to the head to relieve headache. Malay women use the flowers as a cosmetic.

8. **PALAQUIUM** Blanco

(After a Filipino name—*palak-palak*)

A.P. Abang Mohd. Mohtar

(elaborated by E. Soepadmo)

Fl. Filip. ed. 1 (1837) 403, *ibid.* ed. 2 (1845) 282; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 22; Boerlage, Handl. Fl. Ned.-Indie 2, 1 (1891) 302; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 189; Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 1, Bull. Mus. Hist. Nat., Paris 15 (1909) 379; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 14, *ibid.* 3, 8 (1927) 387; Ridley, FMP 2 (1923) 272, *ibid.* 5, Suppl. (1925) 319; Masamune, EPB (1942) 592; Browne, FTSB (1955) 155; P. Royen, Blumea 10 (1960) 433; Keng, OFMSP (1969) 224; Ng, TFM 1 (1972) 415; Anderson, CLTS (1980) 316; Corner, WSTM 3rd edition 2 (1988) 694; Whitmore, Tantra & Sutisna, CLK 2 (1990) 322; Pennington, Gen. Sapot. (1991) 148; Kessler & Sidiyasa, TBSA-EK (1994) 215; Coode *et al.* (eds.), CLBD (1996) 306; Argent *et al.* (eds.), MNDT-CK 2 (1997) 579; Kochummen, TFPF (1997) 412. **Synonyms:** *Bassia* sect. *Apobassia* A.DC., Prodr. 8 (1844) 198; *Dichopsis* Thwaites, Enum. Pl. Zeyl. (1864) 176; *Croixia* Pierre, Not. Bot. Sapot. (1890) 33; *Galactoxylon* Pierre, Not. Bot. Sapot. (1890) 6.

Trees. **Terminal buds** cone-like, glabrous to variously hairy. **Stipules** often present, commonly small and caducous. **Leaves** spirally arranged, well-spaced along twigs or more commonly clustered near ends of twigs, margin entire; lateral veins diminishing and becoming insconspicuous toward leaf margin, or arching and joining into intramarginal vein along leaf margin; intercostal venation scalariform or descending from leaf margin and parallel to lateral veins, or rarely reticulate. **Inflorescences** *1–many-flowered fascicles*, *axillary* or *borne in axils* *of leaf scars*. **Flowers** bisexual, rarely unisexual (plant dioecious), pedicillate; *sepals usually 6*, *in two whorls of 3*, free or slightly united, outer whorl more or less valvate; corolla *lobes normally 6*, *each lobe not divided into segments*, often contorted, rarely imbricate, at anthesis frequently spreading or reflexed, often longer than corolla tube, rarely only equalling it; corolla tube normally glabrous inside; *stamens* (*10–*)*12*(*–30*), exserted, commonly in a single whorl, rarely in two or three alternating whorls, inserted near top of corolla tube or at base of corolla lobes, *filaments free* or sometimes partially united at base, anthers dehiscing extrorsely, introrsely or rarely laterally, frequently sagittate, large, hairy or glabrous; *staminodes absent*; disk (nectary) absent or rarely appears as a small swelling fused to ovary; ovary (5–)6(–10)-loculed, normally hairy, rarely glabrous, style long and tapering, exserted. **Fruits** 1–2(or rarely several)-seeded; pericarp thin or fleshy. **Seeds** usually broadly oblong or ellipsoid or laterally compressed; scar adaxial, broad or narrow; embryo with plano-convex or foliaceous cotyledons, without or with scanty endosperm.

Vernacular names. Sabah—*nyatoh* (preferred name). Sarawak—*njotu* (Bidayuh), *nyatoh* (preferred name), *nyatu* (Bidayuh, Kayan, Sadong), *pulut* (Murut).

Distribution. More than 110 species, ranging from India across SE Asia to the Pacific Islands. Most species are found in the Malesian region with the Philippines and Borneo being the centres of distribution with 32 species and 50 species respectively. In Sabah and Sarawak, 41 species are known.

Ecology. Common constituent of coastal, lowland mixed dipterocarp, freshwater swamp, and montane forests.

Uses. The timber produces a smooth planed surface which is non-durable under exposed conditions. It is suitable for medium construction if properly covered, hence widely used for interior finishing, panelling, partitioning, railings, furniture, mouldings and veneering. *Palaquium* was once known for its commercially prized latex, gutta-percha, which was widely used in the production of cable insulator and dental fillings.

Taxonomy. The genus *Palaquium* was first established in 1837 and typified by *Palaquium lanceolatum* Blanco from the Philippines. P. Royen (Blumea 10 (1960) 544) selected *Ramos 19483* as the neotype for the species due to the absence of Blanco's type specimen. In the past few decades, many species and infraspecific taxa were recognised, which has somehow perplexed the taxonomic position of the genus. The splitting into subspecies and varieties is deemed unnecessary for some species as the taxa involved are either justifiably new species or merely misidentified. Ng (*l.c.* 415) did not recognise any subspecies or varieties in the Malayan species. Likewise, infraspecific taxa reported for Sabah and Sarawak are not accepted in the present account.

Key to *Palaquium* species

1. Leaves well-spaced along twigs..2
   Leaves clustered at ends of twigs..24

2. Lateral veins arching and joining into intramarginal veins along leaf margin.............3
   Lateral veins diminishing and becoming inconspicuous toward leaf margin…..….......9

3. Intercostal venation scalariform……………………………………………………4
Intercostal venation descending from leaf margin and parallel to lateral veins or finely reticulate……………………………………………………………6

4. Leaves glabrous on both surfaces. Fruits oblong or fusiform……………………………………………………………………………………**41. P. xanthochymum** (in part)
Leaves densely golden-tomentose or brownish woolly-pubescent below. Fruits globose or depressed ellipsoid or ellipsoid………………………………………………5

5. Twigs not covered with prominent leaf scars, densely brownish woolly-pubescent. Terminal buds to 10 mm long, densely woolly-pubescent. Stipules ovate. Leaves chartaceous; lateral veins 12–14 pairs. Stamens 18, anthers oblong….**19. P. majas**
Twigs covered with prominent leaf scars, densely reddish-brown or golden tomentose. Terminal buds to 6 mm long, brownish tomentose. Stipules lanceolate. Leaves coriaceous; lateral veins 13–35 pairs. Stamens 12, anthers narrowly ovoid or sagittate… ……………………………………………………**11. P. gutta** (in part)

6. Leaves coriaceous, glabrous above, brownish tomentose below……………………………………………………………………………………**20. P. microphyllum** (in part)
Leaves chartaceous to subcoriaceous, glabrous on both surfaces……………………7

7. Twigs reddish-brown tomentose. Stipules lanceolate, *c.* 1.5 × 0.5 mm. Inflorescences axillary or crowded along leafless parts of twigs; ovary discoid……………………………………………………………………………………**31. P. rostratum** (in part)
Twigs glabrous. Stipules small, soon caducous. Inflorescences axillary; ovary ovoid………………………………………………………………………………………8

8. Leaf apex acuminate; petiole glabrous. Pedicel 7–12 mm long. Fruits 2–5 × 1.3–4 cm, 1-seeded. Seed obovoid, *c.* 1 × 0.8 cm…………..**24. P. pseudocuneatum** (in part)
Leaf apex rounded or obtuse; petiole brownish tomentose. Pedicel 3–4.5 mm long. Fruits 1–1.4 × 0.8–1.6 cm, 1–2-seeded. Seeds ellipsoid, *c.* 0.9 × 0.6 cm…………………………………………………………………………………**25. P. pseudorostratum**

9. Lateral veins more than 16 pairs…………………………………………………10
Lateral veins less than 16 pairs or rarely to 16 pairs……………………………14

10. Leaves thinly chartaceous. Stipules oblong…………………………**30. P. rivulare**
Leaves subcoriaceous to coriaceous. Stipules lanceolate, triangular-lanceolate, linear-lanceolate or scale-like…………………………………………………11

11. Twigs, lower leaf surface and pedicel brownish sericeous. Terminal buds to 5 mm long. Petiole 8–10 cm long, flat on adaxial side…………………………**33. P. sericeum**
Twigs, lower leaf surface and pedicel otherwise. Terminal buds to 15 mm long. Petiole 1.5–4 cm long, grooved on adaxial side………………………………………………12

12. Terminal buds 7–8.5 mm long. Lateral veins 16–17 pairs……….**29. P. rioensis**
Terminal buds to 15 mm long. Lateral veins 16–24 pairs…………………………13

13. Stipules scale-like, 4–10 × 3–5 mm. Leaves glabrous above, yellowish-brown tomentose below; lateral veins ascending at an angle of 50–60° from midrib. Stamens 19–27; anthers sagittate...**35. P. stipulare**
Stipules lanceolate, *c.* 5 × 1.5 mm. Leaves glabrous on both surfaces. Lateral veins ascending at an angle of 70–85° from midrib. Stamens 12; anthers oblong-ovoid......... ....**36. P. sumatranum**

14. Leaves glabrous on both surfaces..15
Leaves variously hairy below, at least on midrib and lateral veins...............17

15. Terminal buds to 10 mm long. Stipules lanceolate. Leaves chartaceous; lateral veins 12–14 pairs...**38. P. tenuipetiolatum**
Terminal buds to 4 mm long. Stipules triangular or triangular-lanceolate. Leaves subcoriaceous to coriaceous; lateral veins 5–12 pairs......................................16

16. Leaves coriaceous; lateral veins 5–8 pairs, prominulous on both sides; intercostal venation inconspicuous below. Petiole greyish tomentose. Anthers sagittate, tomentose ....**21. P. multiflorum**
Leaves subcoriaceous; lateral veins 7–12 pairs, impressed above, prominent below; intercostal venation prominulous below. Petiole glabrous. Anthers ellipsoid, glabrous ....**40. P. walsurifolium** (in part)

17. Twigs, lower leaf surface, petiole and pedicel shiny golden-sericeous. Stipules linear ....**2. P. calophyllum**
Twigs, lower leaf surface, petiole and pedicel otherwise. Stipules not so...............18

18. Leaves larger, (8–)10–32 × (3.5–)4–8.5(–10) cm................................19
Leaves smaller, 5–10(–12) × 1.8–4(–6 cm)...21

19. Terminal buds 3–4 mm long, reddish tomentose with woolly hairs. Intercostal venation inconspicuous on both sides. Anthers oblong, long-acuminate or bifid..................... ....**6. P. dasyphyllum**
Terminal buds to 10 mm long, brownish pubescent. Intercostal venation conspicuous on both sides. Anthers ovoid or sagittate...20

20. Stipules lanceolate, *c.* 6 × 3 mm. Leaves chartaceous; lateral veins ascending at an angle of 55–65° from midrib. Petiole 1–1.2 cm long, flat and crested on adaxial side... ....**17. P. lisophyllum**
Stipules linear-lanceolate, *c.* 10 × 2 mm. Leaves subcoriaceous; lateral veins ascending at an angle of 45–50° from midrib. Petiole 4–6 cm long, grooved on adaxial side...... ....**26. P. quercifolium**

21. Terminal buds to 5 mm long. Twigs subterete. Leaves sparsely tomentose below or brownish woolly-tomentose on midrib and lateral veins only; lateral veins 6–10 pairs. Petiole flat on adaxial side..22
Terminal buds to 10 mm long. Twigs angular. Leaves densely brownish-tomentose or sericeous below; lateral veins 8–15 pairs. Petiole grooved on adaxial side.........23

22. Twigs initially hairy, soon becoming glabrous. Leaves sparsely tomentose below; lateral veins prominulous above, prominent below. Sepals ovate; anthers cordate-ovate; ovary glabrous……………………………………………………**4. P. crassifolium**
Twigs brownish pubescent with persistent long woolly-hairs. Leaves brownish woolly-tomentose on midrib and lateral veins only; lateral veins prominent on both sides. Sepals lanceolate; anthers sagittate; ovary densely brownish-hairy…………………….. ……
……………………………………………………………**5. P. cryptocariifolium**

23. Stipules lanceolate, *c.* 4 × 2.5 mm. Leaves coriaceous; lateral veins ascending at an angle of 30–40° from midrib. Inflorescences borne in axils of leaf scars; anthers ovoid-oblong, dehiscing laterally or subextrorsely……………….………**10. P. ferrugineum**
Stipules twisted and flag-shaped, to 8 mm long. Leaves chartaceous; lateral veins ascending at an angle of 60–65° from midrib. Inflorescences axillary; anthers sagittate, dehiscing extrorsely…………………………….……….**39. P. vexillatum**

24. Lateral veins arching and joining into intramarginal vein along leaf margin……25
Lateral veins diminishing and becoming inconspicuous toward leaf margin……..31

25. Twigs covered with prominent leaf scars………………………………………26
Twigs otherwise……………………………………………………………………29

26. Leaves coriaceous, densely dark reddish-brown woolly pubescent or golden tomentose below. Stipules lanceolate………………………………………………….…27
Leaves membranaceous, chartaceous to subcoriaceous, glabrous on both surfaces or pubescent on midrib only. Stipules ovate…………….……………………………28

27. Leaves larger, 18–37.5 × 4–14 cm; lateral veins 27–35 pairs, ascending at an angle of *c.* 60°. Inflorescences borne on twigs below leaves or in axils of terminal leaves. Pedicel 4–6 mm long; corolla 8–10 mm long………………………………**1. P. beccarianum**
Leaves smaller, 9.5–13 × 3–8 cm; lateral veins 13–27 pairs, ascending at an angle of 75–85°. Inflorescences axillary. Pedicel 3–15 mm long; corolla to 2 mm long…………
…………………………………………………………**11. P. gutta** (in part)

28. Terminal bud to 3 mm long. Leaves pubescent on midrib only; lateral veins 13–15 pairs; intercostal venation laxly reticulate. Inflorescences borne in axils of leaf scars; pedicel 8–12 mm long; anthers lanceolate; ovary brownish hirsute. Fruits globose, 1.2–1.5 cm diameter; pericarp thin. Seeds laterally compressed; scar covering *c.* one third of seed surface……………………………………………………**32. P. rufolanigerum**
Terminal bud to 6 mm long. Leaves glabrous on both surfaces; lateral veins 14–20 pairs; intercostal venation scalariform or subreticulate. Inflorescences axillary; pedicel 3–9 mm long; anthers oblong; ovary glabrous. Fruits oblong or fusiform, *c.* 3.5 × 1.5 cm; pericarp fleshy. Seeds fusiform; scar covering about half of seed surface…………..
…………………………………………………**41. P. xanthochymum** (in part)

29. Leaves coriaceous, glabrous above, brownish tomentose below. Fruits globose, *c.* 2.5 cm diameter…………………………………………**20. P. microphyllum** (in part)
Leaves chartaceous to subcoriaceous, glabrous on both surfaces. Fruits ellipsoid, 2–5 × 1.2–4 cm……………………………………………………………………………30

30. Twigs glabrous. Stipules small, caducous. Leaves subcoriaceous; lateral veins 12–14 pairs; petiole to 1.5 cm long, grooved on adaxial side……………………………………………………………………………………**24. P. pseudocuneatum** (in part)
Twigs reddish-brown tomentose. Stipules lanceolate, *c.* 1.5 × 0.5 mm. Leaves chartaceous; lateral veins 15–18 pairs; petiole to 4 cm long, flat on adaxial side………………………………………………………………………**31. P. rostratum** (in part)

31. Leaves glabrous on both surfaces……………………………………………32
Leaves variously hairy at least on lower surface and/or midrib and lateral veins only………………………………………………………………………………36

32. Twigs glabrous……………………………………………**3. P. cochlearifolium**
Twigs variously hairy……………………………………………………33

33. Leaves elliptic; lateral veins 17–20 pairs. Pedicel 18–21.5 mm long. Fruits ovoid…….. ……………………………………………………**9. P. elegans**
Leaves obovate; lateral veins 8–12(–17) pairs. Pedicel 7–17 mm long. Fruits globose, subglobose or obovoid……………………………………………………34

34. Stipules triangular, *c.* 2.5 mm across. Pedicel 15–17 mm long; anthers ellipsoid. Fruits subglobose……………………………………**40. P. walsurifolium** (in part)
Stipules ovate or ovate-lanceolate, 2–2.5 × 1–2 mm. Pedicel 7–15 mm long; anthers oblong. Fruits globose or obovoid……………………………………………35

35. Stipules ovate-lanceolate, *c.* 2 × 1 mm. Leaves subcoriaceous to thickly coriaceous; lateral veins 8–10 pairs, ascending at an angle of *c.* 45° from midrib; petiole 0.8–2 cm long. Ovary ellipsoid, glabrous. Fruits obovoid, *c.* 1.5 × 1 cm……..……...**27. P. ridleyi**
Stipules ovate, *c.* 2.5 × 2 mm. Leaves chartaceous; lateral veins 12–17 pairs, ascending at an angle of 65–75° from midrib; petiole 2–2.8 cm long. Ovary disc-like, brownish tomentose. Fruits globose, 8–10 cm diameter……………………………**28. P. rigidum**

36. Leaves sparsely greyish hairy on both surfaces or pubescent on midrib and lateral veins only……………………………………………………………………37
Leaves variously densely hairy on lower side……………………………………38

37. Leaves sparsely greyish-hairy on both surfaces; broadly obovate, 3–7.5 × 2–5 cm; lateral veins ascending at an angle of 40–45° from midrib; intercostal venation inconspicuous on both sides; petiole crested or flat on adaxial side. Ovary sparsely tomentose. Fruits ellipsoid, 1–1.4 × 0.7–1 cm, 1-seeded…………………**12. P. herveyi**
Leaves stellate-hairy on midrib and lateral veins only; elliptic to oblong, 9–13.5 × 3–5 cm; lateral veins ascending at an angle of *c.* 55° from midrib; intercostal venation conspicuous on both sides; petiole shallowly grooved on adaxial side. Ovary brownish hirsute. Fruits subglobose to globose, 2–2.5 cm across, 1–3-seeded…...**34. P. stellatum**

38. Leaves smaller, 5–11 × 2–4 cm; lateral veins 6–11 pairs………………………39
Leaves larger, (10–)14–25(–38) × 5–16.5 cm; lateral veins (10–)12–30 pairs...40

39. Leaves coriaceous; lateral veins ascending at an angle of 40–45° from midrib. Flowers in fascicles of 2–3. Fruits ellipsoid, *c.* 1.5 × 1 cm…………………………....**8. P. edenii**
Leaves chartaceous to subcoriaceous; lateral veins ascending at an angle of 60–70° from midrib. Flowers in fascicles of to 18. Fruits globose or ovoid, 2–3 × 1.5–2 cm…... ……………………………………………………………………**13. P. hexandrum**

40. Leaves chartaceous to subcoriaceous……………………………………………41
Leaves coriaceous…………………………………………………………………42

41. Terminal buds to 12 mm long. Lateral veins 18–24 pairs. Anthers dehiscing laterally. Ovary subglobose, brownish pubescent. Fruits ellipsoid, 2–3 × 1.5–2 cm……………… ……………………………………………………………………**7. P. decurrens**
Terminal buds to 20 mm long. Lateral veins 10–18 pairs. Anthers dehiscing extrorsely. Ovary conical, glabrous. Fruits globose, 2.5–3 cm diameter……..**22. P. obovatum**

42. Terminal buds 8–12 mm long…………………………………………………43
Terminal buds 14–20 mm long………………………………………………45

43. Stipules to 10 mm long. Intercostal venation prominent on both sides. Petiole *c.* 1.5 cm long. Pedicel *c.* 25 mm long; anthers ovoid………………………..….**37. P. supfianum**
Stipules 5–7 × 3.5 mm. Intercostal venation prominulous or inconspicuous above. Petiole 1.5–5 cm long. Pedicel 4–18 mm long; anthers lanceolate-oblong or sagittate…. ……………………………………………………………………….44

44. Leaves densely yellowish tomentose below, 12–24 × 6–15 cm; lateral veins 15–16 pairs. Pedicel to 4 mm long; anthers lanceolate-oblong; ovary glabrous. Fruits ovoid, *c.* 1 × 0.6 cm………..……...…………………………………...**15. P. kinabaluense**
Leaves densely rusty-brown tomentose below, 10–17 × 5.5–12 cm; lateral veins 13–23 pairs. Pedicel 8–18 mm long; anthers sagittate; ovary brownish tomentose. Fruits ellipsoid or globose, 1–3 × 1–2.5 cm……………………………**16. P. leiocarpum**

45. Twigs brownish pubescent with hirsute hairs. Lateral veins 19–30 pairs, ascending at an angle to 50° from midrib; petiole to 0.5 cm long. Pedicel to 5 mm long. Fruits subglobose, 1.8–2.4 × 1.4–1.8 cm…………………………………**14. P. hispidum**
Twigs brownish woolly-tomentose, glabrescent. Lateral veins 12–22 pairs, ascending at an angle of 50–65° from midrib; petiole 2–6 cm long. Pedicel 7–20 mm long. Fruits ellipsoid, globose or ovoid-oblong, 3.5–7 × 2.5–3 cm…………………………46

46. Leaves smaller, 16–24 × 8.5–15 cm; intercostal venation prominent on both sides; petiole brownish woolly-tomentose. Pedicel 7–11 mm long; corolla to 12 mm long; anthers sagittate; ovary discoid, glabrous. Fruits ellipsoid or globose, *c.* 3.5 × 2.5 cm………………………………………………………………**18. P. maingayi**
Leaves larger, 26–33 × 10.5–16.5 cm; intercostal venation inconspicuous above, prominent below; petiole glabrous. Pedicel 8–20 mm long; corolla 15–20 mm long, anthers oblong; ovary subglobose to ovoid, hirsute. Fruits ovoid-oblong, *c.* 7 × 3 cm ……………………………………………………………………**23. P. ottolanderi**

1. **Palaquium beccarianum** (Pierre) P.Royen. Fig. 17.

(After Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Blumea 8 (1957) 424, *ibid.* 10 (1960) 461; Anderson *l.c.* (1980) 316; Whitmore, Tantra & Sutisna *l.c.* 322. Argent *et al.* (eds.) *l.c.* 581; Kessler & Sidiyasa *l.c.* 216. **Basionym:** *Croixia beccariana* Pierre, Not. Bot. Sapot. (1890) 33. **Type:** *Beccari PB 4069*, Borneo, Sarawak, Kuching, Matang (holotype P; isotypes Fl, L). **Synonyms:** *Planchonella beccariana* (Pierre) H.J.Lam *l.c.* (1925) 216, *l.c.* (1927) 382, 475; *Planchonella pierreana* Dubard, Ann. Mus. Col. Mars. 20 (1912) 60; *Palaquium ferox* H.J.Lam *l.c.* (1925) 70, 256, *l.c.* (1927) 401, *p.p.*, *excl. specim. Hamid 10582.*

Tree to 20 m tall. **Bark** reddish brown, deeply regularly fissured; inner bark pinkish. **Twigs** stout, 8–17 mm diameter, *covered with prominent leaf scars*, densely dark reddish-brown woolly pubescent. **Terminal buds** to 5 mm long, densely dark reddish-brown woolly pubescent. **Stipules** *lanceolate*, *c.* 10 × 5 mm, apex obtuse, densely tomentose outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, *densely dark reddish-brown woolly pubescent below*; oblanceolate or obovate to obovate-oblong, *18–37.5 × 4–14 cm*, base narrowly acute, apex acute to rounded; midrib impressed and crested above, prominent below; *lateral veins 27–35 pairs*, *ascending at an angle of c. 60° from midrib*, *arching and joining into intramarginal vein along leaf margin*; intercostal venation scalariform; petiole 2–4 cm long, grooved on adaxial side, densely dark reddish-brown woolly pubescent. **Inflorescences** *borne on twigs below leaves* or *in axils of terminal leaves*; fascicles 3–5-flowered. **Flowers:** *pedicel* angular, *4–6 mm long*, reddish-brown pubescent; sepals ovate to lanceolate, 3–5 × 2–2.5 mm, apex of outer sepals obtuse, that of inner sepals acute, pubescent outside, glabrous inside; *corolla 8–10 mm long*, lobes ovate to elliptic, apex obtuse; stamens 12, filaments slender, *c.* 8 mm long, *anthers narrowly ovoid*, 2–2.5 mm long; ovary discoid-conoid, *c.* 1.5 × 2 mm, 6-loculed, glabrous, style subulate, 14–18 mm long, glabrous. **Fruits** ellipsoid, 2.5–3.5 × 1.5–2 cm, apex obtuse, 1-seeded, with persistent sepals; pericarp fleshy, glabrous. **Seeds** ellipsoid, 2–2.6 × 1–1.7 cm, apex mucronate, base acuminate; scar covering about half of seed surface.

Vernacular name. Sabah—*nyatoh bulu* (Malay).

Distribution. Endemic to Borneo. In Sarawak, mainly found in Kuching Division (e.g., *Beccari PB 4069*), and particularly common in the Semengoh FR. In Sabah, mostly recorded from Sandakan district (e.g., *KEP 70519*, *SAN 17670*, *SAN 92727*, and *Sinclair 9319*). Also occurs in Kalimantan (e.g., *bb. 10410*, *bb. 15849*, *bb. 29316*, *Kostermans 5401* and *Kostermans 6714*).

Ecology. Mostly in lowland mixed dipterocarp forest on fertile loamy soils; occassionally also in limestone forest.

2. **Palaquium calophyllum** (Teijsm. & Binn.) Pierre Fig. 18.

(Greek, *calophyllum* = with beautiful leaves)

In Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 28; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 279; H.J. Lam *l.c.* (1925) 52, *l.c.* (1927) 398; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 558; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 150; Coode *et al.* (eds.) *l.c.* 306; Argent *et al.* (eds.) *l.c.* 581. **Basionym:** *Isonandra calophylla* Teijsm. & Binn., Nat. Tijdschr. Ned.-Indie 27 (1864) 35. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan (holotype BO). **Synonyms:** *Dichopsis calophylla* (Teijsm. & Binn.) Benth. & Hook.*f.*, Gen. Pl. 2. (1876) 658; *Croixia calophylla* (Teijsm. & Binn.) Baehni, Boissiera 11 (1965) 109.

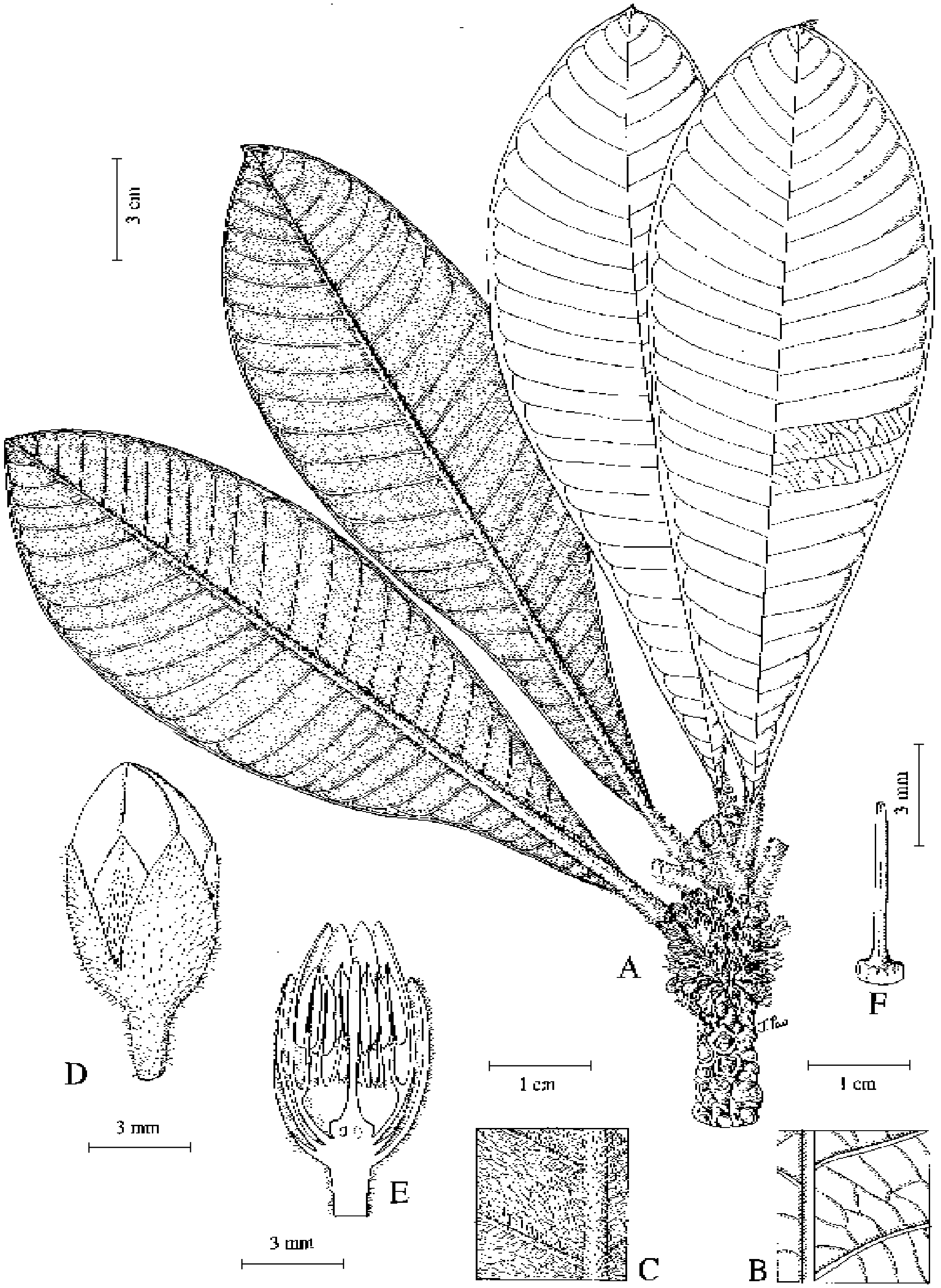

Fig. 17. *Palaquium beccarianum*. A, flowering leafty twig; B, detail of leaf venation; C, indumentum on lower leaf surface; D, flower bud; E, longitudinal section of flower bud; F, pistil. (All from *SAN 92727*.)

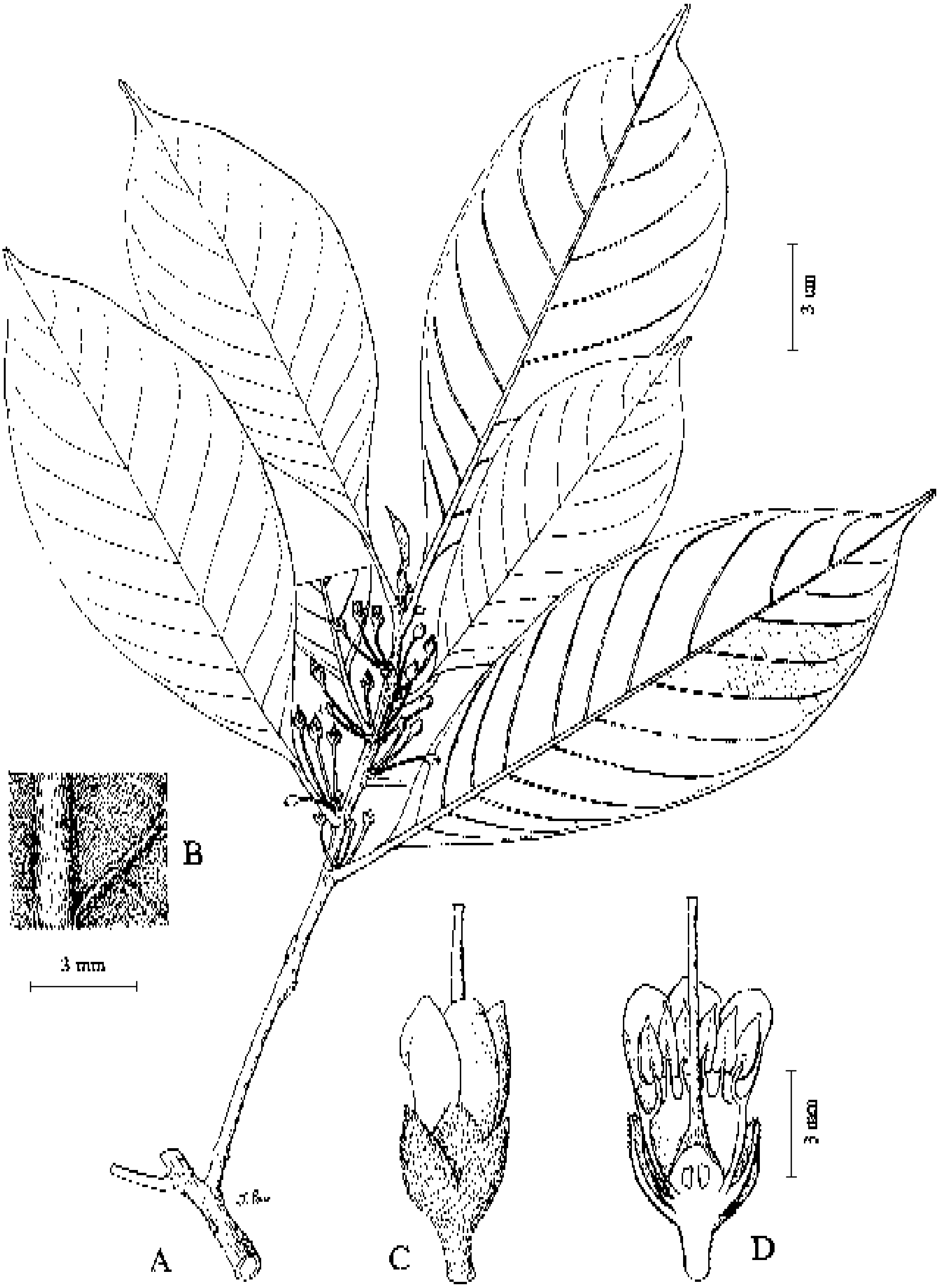

Fig. 18. *Palaquium calophyllum.* A, flowering leafy twig; B, indumentum on lower leaf surface; C, flower; D, longitudinal section of flower. (All from *S 18487.*)

Tree to 20 m tall. **Bark** brownish grey, smooth to slightly cracked, inner bark light brown to cream. **Twigs** subterete to angular, slender, 2–5 mm diameter, *shiny golden-sericeous*, older twigs brownish. **Terminal buds** 5–7 mm long. **Stipules** *linear*, 3.5–4 × 1.5–2 mm, brownish tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, chartaceous or coriaceous, glabrous above, *shiny golden-sericeous below*; elliptic to obovate, 9–23.5 × 3.5–11 cm, base cuneate, decurrent, apex acute to acuminate; midrib impressed above, prominent below; *lateral veins 8–16 pairs*, ascending at an angle of 40–45° from midrib, straight and parallel, arching, *diminishing and becoming inconspicuous toward leaf margin*, insconspicuous above, prominent below; intercostal venation scalariform, inconspicuous above, fine but distinct below; *petiole* 1.5–2.5 cm long, grooved on adaxial side, swollen at base, *shiny golden-sericeous*. **Inflorescences** axillary or in axils of leaf scars, fascicles 2–12-flowered. **Flowers:** *pedicel* angular, 10–30 mm long, *shiny golden-sericeous*; sepals triangular or ovate, 3–4 × 2.5–3.5 mm, golden tomentose outside, glabrous inside; corolla 5–6 mm long, sparingly hairy especially in the middle of lobes, lobes lanceolate, obtuse at apex, at anthesis reflexed; stamens 12, filaments 2–3.5 mm long, subulate, angular, glabrous, anthers sagittate to ovoid (sometimes bifid), dehiscing laterally, brownish tomentose; ovary conical, 2.5–3 mm long, 6-loculed, 6-lobed, sericeous, style slender, sericeous at base. **Fruits** globose, 1.5–2 cm diameter, 1–2-seeded; pericarp hard, densely tomentose. **Seeds** almost globose, *c.* 1 × 0.8 cm; scar covering to one third of seed surface.

Vernacular name. Sarawak—*nyatu dien* (Bidayuh).

Distribution. Sumatra, Borneo, the Philippines, Maluku, and New Guinea. Recorded throughout Sabah and Sarawak. Particularly common in Bako NP in the southwestern part of Sarawak (e.g., *Clemens 22200*, *S 18487*, *S 37838*, *S 43583*, and *S 49883*) and in the southwestern part of Sabah (e.g., *SAN 16778*, *SAN 16985*, *SAN 23067*, *SAN 88368*, and *SAN 117537*). Also occurs in the eastern part of Kalimantan (e.g., *bb. 15242*, *bb. 29707*, *Kostermans 6668*, *Kostermans 7030*, *Tuke P2 336*, and *Tuke P2 488*), and in Brunei (e.g., *BRUN 894* and *BRUN 3398*).

Ecology. Mostly in mixed dipterocarp forest at altitudes to 800 m; also in alluvial forest and *kerangas* forest.

3. **Palaquium cochlearifolium** P.Royen Fig. 19.

(Latin, *cochlearis* = spoon-shaped, *folium* = leaf; the spoon-shaped leaves)

Blumea 10 (1960) 545; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 150; Coode *et al.* (eds.) *l.c.* 306; Argent *et al.* (eds.) *l.c.* 581. **Type:** *Buwalda 7810*, Borneo, Kalimantan, Sampit (holotype L; isotypes BO, PNH, SING).

Tree to 30 m tall, 45 cm diameter. **Bark** dark brown, shallowly cracked to irregularly fissured, sometimes with soft lenticels between fissures; inner bark pinkish to red, fibrous. **Twigs** stout, terete, 4–8 mm diameter, with numerous leaf scars, *glabrous*. **Terminal buds** to 5 mm long, glabrous. **Stipules** triangular, *c.* 1 × 1 mm, glabrous, caducous. **Leaves** *clustered at ends of twigs*, coriaceous, *glabrous on both surfaces*; cochleate or obovate, 9.5–17 × 4–7.5 cm; base cuneate to rounded, apex rounded, subobtuse, acute or obtusely short-acuminate; midrib flat and crested above, prominent below; *lateral veins* 6–10 pairs, ascending at an angle of 75–85° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, faint to distinct on both sides; intercostal venation scalariform, faint to prominent on both sides; petiole 1.5–5 cm long, grooved

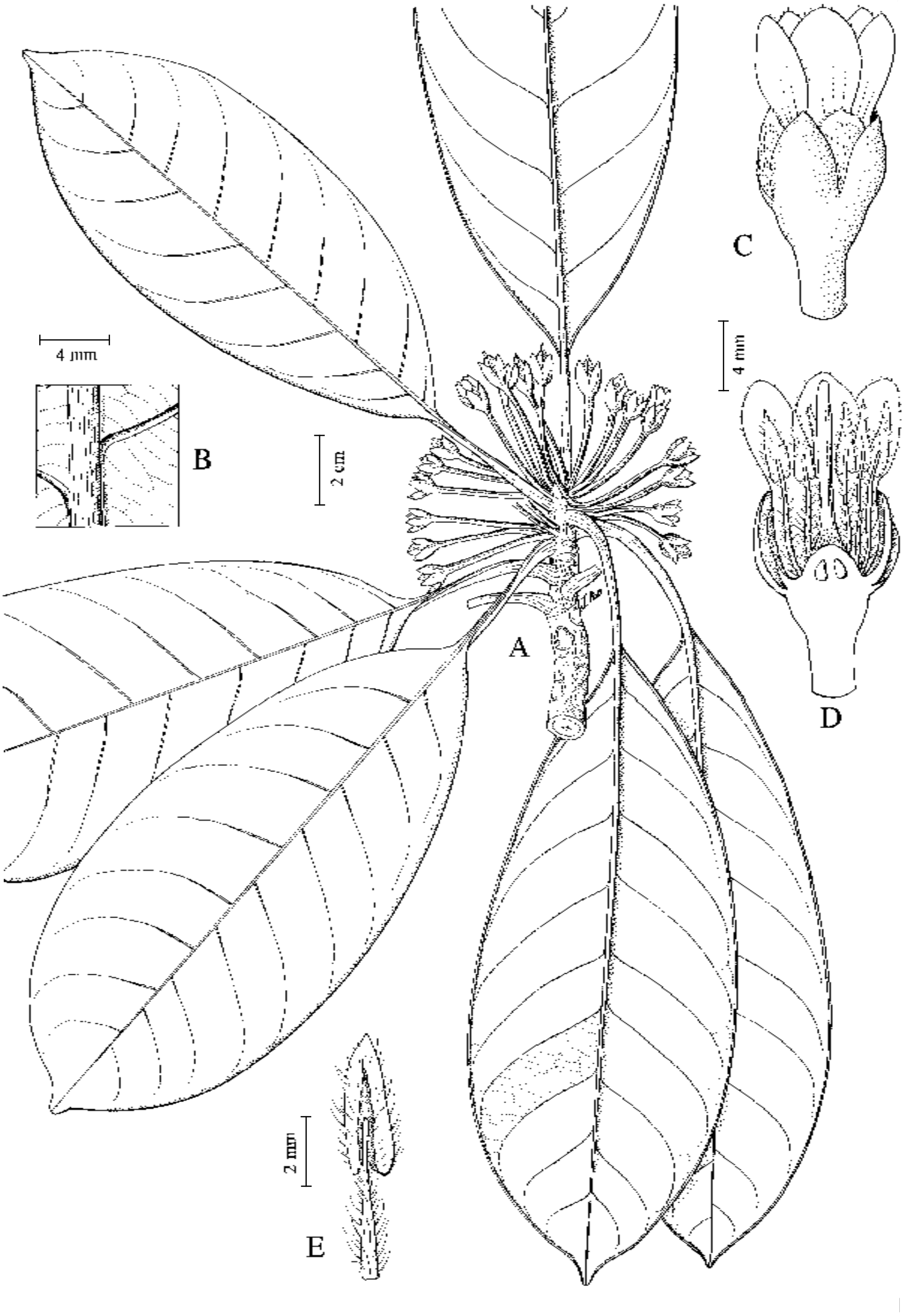

Fig. 19. *Palaquium cochlearifolium*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower; D, longitudinal section of flower; E, stamen. (All from *S 8697.*)

and crested on adaxial side, thickened at base, glabrous. **Inflorescences** axillary or terminal, fascicles 3–14-flowered. **Flowers:** pedicel angular, 20–35 mm long, glabrous; sepals ovate, 5–8 × 4–5 mm, outer ones glabrous on both sides, inner ones pubescent with short hairs outside, glabrous inside; corolla lobes elliptic, to 10 mm long; stamens 12, filaments linear, 3–10 mm long, anthers oblong, 2–3 mm long, hairy, dehiscing extrorsely; ovary conical, 6-loculed, hairy at base, style 4–9 mm long, sparsely hairy. **Fruits** ellipsoid, *c.* 2.5 × 2 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** *c.* 1.5 × 1 cm; scar covering to half of seed surface.

Vernacular names. Sabah—*paga* (Kadazan). Sarawak—*nyatoh jelutong*, *nyatoh temiang* (Iban).

Distribution. Endemic to Borneo. Locally common in Sabah (e.g., *KEP 48496* and *SAN A 1731*) and Sarawak (e.g., *S 653*, *S 1418*, *S 2867*, *S 8697*, and *S 57113*). Also occurs in Brunei (e.g., *BRUN 978*, *BRUN 3248*, *S 5860*, and *SAN 17443*) and Kalimantan (e.g., *bb. 13476*, *bb. 15688*, *bb. 33043*, and *Buwalda 7810*).

Ecology. Exclusively a swamp forest species, particularly common in the *Dacrydium-Casuarina* association of peat swamp forest in Lawas, Sarawak. Also occurs in *kerangas* forest throughout Sabah and Sarawak.

4. **Palaquium crassifolium** Pierre *ex* Dubard

(Latin, *crassus* = thick; *folium* = leaf; having thick leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 23; H.J. Lam *l.c.* (1925) 35, *l.c.* (1927) 391; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 490; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 152 (as a doubtful species). **Type:** *Beccari PB 2099*, Borneo, Sarawak (holotype P; isotypes FI, L).

Tree. **Twigs** *subterete*, slender, *c.* 2.5 mm diameter, *initially hairy*, *soon becoming glabrous*. **Terminal buds** *to 5 mm long*. **Stipules** *lanceolate*, *c.* 4 × 2 mm, apex acute, light brown tomentose outside, brownish hairy inside, caducous. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous above, *sparsely tomentose below*; obovate, *8–10 × 2.6–5 cm*, base cuneate, apex obtuse or nearly so; midrib impressed above, prominent below; *lateral veins 6–7 pairs*, ascending at an angle of *c.* 45° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, *prominulous above*, *prominent below*; intercostal venation laxly scalariform, inconspicuous on both sides; *petiole* 1–1.6 cm long, *flat on adaxial side*, slightly thickened at base, *brownish tomentose*, glabrescent. **Inflorescences** axillary, fascicles 2–3-flowered. **Flowers:** *pedicel brownish tomentose*; *sepals* 4 or 6, *ovate*, 2–2.5 × 1.8–2.2 mm, brownish tomentose outside, glabrous inside, inner sepals with hairy margin; corolla lobes spathulate, 4 or 6, *c.* 4.2 × 2.2 mm; stamens 12, sometimes 9, inserted at base of corolla lobes, filaments subulate, 2–2.5 mm long, *anthers cordate-ovate*, 2–2.5 mm long, apex apiculate, sparsely hairy; *ovary* ovoid, *c.* 2 × 1 mm, 6-loculed, *glabrous*, style slender, 6–8 mm long, glabrous. **Fruits** and **seeds** unknown.

Vernacular name. Sarawak—*nyatoh temiang* (Iban).

Distribution. Endemic to Borneo. Rare, known only by a few collections from Sarawak (e.g., *Beccari PB 2099*, *Egon 934* and *S 68746*).

Ecology. In mixed dipterocarp forest.

5. **Palaquium cryptocariifolium** P.Royen

(Latin, with leaves resembling those of the genus *Cryptocarya*, Lauraceae)

Blumea 10 (1960) 504, *p.p.*, *excl.* fig. 8 (= *P. reginamontium* Ng); Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 322. **Type:** *Forest Service Sarawak 1*, Borneo, Sarawak, Semengoh FR (holotype E; isotype L).

Tree to 35 m tall. **Bark** finely fissured, brownish grey, inner bark laminated, reddish brown. **Twigs** *subterete*, slender, *c.* 3 mm diameter, *brownish pubescent with persistent long woolly-hairs*. **Terminal buds** *to 4 mm long*, brownish tomentose. **Stipules** *ovate-lanceolate*, *c.* 5 × 3 mm, brownish tomentose. **Leaves** *mostly well-spaced along twigs*, rarely clustered at ends of twigs, subcoriaceous, *brownish woolly-tomentose on midrib and lateral veins on both surfaces*; obovate to obovate-elliptic, *6–12 × 3–6 cm*, base cuneate, apex obtuse to acuminate; *lateral veins 6–10 pairs*, ascending at an angle of 45–50° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, *prominent on both sides*; intercostal venation scalariform, fine, obscure on both sides; *petiole* 1–3 cm long, *flat on adaxial side*, rounded on abaxial side, *densely brown-hairy*. **Inflorescences** axillary, densely crowded along apical portion of shoots. **Flowers:** *pedicel* angular, 3–8 mm long, *densely brownish-hairy*; *sepals* 6, *lanceolate*, *c.* 4.5 × 2 mm, apex obtuse, brownish hairy outside, glabrous inside, inner sepals glabrous; corolla 4–5.5 mm long, sparsely hairy, petals 6, narrowly ovate, apex truncate, fimbriate; stamens 12, filaments subulate, *c.* 1 mm long, glabrous, *anthers sagittate*, 1–1.5 mm long, sparsely brownish-hairy, dehiscing extrorsely; *ovary* conical, *c.* 2.5 × 1.5 mm, 6–7-loculed, *densely brownish-hairy*, style subulate, *c.* 2.5 mm long, glabrous. **Fruits** ellipsoid, 1–2 × 1–1.5 cm, glabrous, normally 1-seeded. **Seeds** *c.* 1.4 × 1 cm.

Distribution. Endemic to Borneo. Recorded from the southwestern and northernmost parts of Sarawak (e.g., *Caroll 1166*, *S 0168*, *S 17891*, *S 37011*, and *S 38342*). Also occurs in C Kalimantan.

Ecology. In mixed dipterocarp forest and *kerangas* forest.

6. **Palaquium dasyphyllum** Pierre *ex* Dubard

(Greek, *dasus* = thickly hairy, *phullon* = leaf; alluding the lower surface of leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 8; H.J. Lam *l.c.* (1925) 73, *l.c.* (1927) 405; Masamune, *l.c.* 593; P. Royen *l.c.* (1960) 497; Anderson *l.c.* 317, Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150; Argent *et al.* (eds.) *l.c.* 583. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan, Bandjarmasin (holotype BO; isotype L). **Synonyms:** *Isonandra dasyphylla auct. non* Miq.: de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 307; *Palaquium stenophyllum* H.J.Lam *l.c.* (1925) 97, *l.c.* (1927) 411, Merrill, PEB (1929) 238.

Tree to 36 m tall, 65 cm diameter. **Bark** smooth, dark brown, inner bark chocolate brown. **Twigs** terete, slender, 2–4 mm diameter, *densely brownish-tomentose* towards terminal bud. **Terminal buds** *3–4 mm long*, *reddish tomentose with woolly hairs*. **Stipules** *linear-lanceolate*, *c.* 9 × 2 mm, densely reddish to brownish tomentose, caducous. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous above except for the orange-red hairy basal part of midrib, *appressed hairy below*; oblong to elliptic, *10–23 × 4–7.5 cm*, base cuneate, apex obtuse to rounded or obtusely acuminate; midrib impressed above, rounded and prominent below; *lateral veins 9–12* *pairs*, ascending at an angle of 40–75° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly conspicuous and impressed above, prominent below; *intercostal venation* scalariform, *inconspicuous on both sides*; *petiole* 1.3–2 cm long, grooved on adaxial side, thickened towards base, *brownish woolly-tomentose* or partly glabrescent. **Inflorescences** axillary, fascicles 2–10-flowered. **Flowers:** *pedicel* angular, *brownish pubescent with hirsute hairs*; sepals ovate-oblong to linear-lanceolate, 3.5–5 × 1.5–3 mm, tomentose outside, glabrous inside, inner sepals glabrous; corolla lobes lanceolate, 6.5–12 mm long, glabrous except for some part outside corolla tube which is brownish sericeous; stamens 12, filaments linear, 1–3 mm long, *anthers oblong*, 3–4 mm long, *long-acuminate* or *bifid*, dehiscing extrorsely or laterally, brownish sericeous; ovary ovoid, 2.5 × 2–2.5 mm, 6-loculed, appressed hairy, style slender, 10–15 mm long, glabrous but pubescent at base. **Fruits** ovoid, obovoid to ellipsoid, 1–2.4 × 0.8–1.5 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** spindle-shaped, *c.* 1.2 × 0.5 cm; scar covering about half of seed surface.

Vernacular name. Sabah—*nyatoh sidang* (Dusun).

Distribution. Sumatra and Borneo. In Borneo, common especially in Sandakan and Tawau districts in Sabah (e.g., *SAN 30356*, *SAN 30973*, *SAN 31384*, *SAN 35851*, and *SAN 88152*), and in Kapit and Marudi districts in Sarawak (e.g., *Haviland 508*, *S 21820*, *S 23028*, *S 23084*, and *S 33559*). Also known in Kalimantan (e.g., *bb. 6823*, *bb. 13755*, *Kostermans 4271*, and *Kostermans 6823*) and possibly in Brunei.

Ecology. In hill mixed dipterocarp to montane forests, at altitudes above 950 m, rarely in *kerangas* and limestone forest.

7. **Palaquium decurrens** H.J.Lam

(Latin, *decurrens* = running down; referring to the leaf base)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 51, *l.c.* (1927) 398; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 487; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323; Argent *et al.* (eds.) *l.c.* 583. **Type:** *Hallier 357*, Borneo, Kalimantan, Lumukutan (holotype BO; isotypes L, NY).

Trees to 34 m tall, 50 cm diameter. **Bark** dark brown, finely fissured to finely flaky, inner bark pink and grey-mottled. **Twigs** stout, subterete to angular, 8–12 mm diameter, brownish sericeous, glabrescent. **Terminal buds** *to 12 mm long*, brownish sericeous. **Stipules** lanceolate, 5 × 3–4 mm, brownish sericeous, caducous. **Leaves** *clustered at ends of twigs*, *chartaceous*, glabrous above, *densely brownish-sericeous below*; obovate, *25–38 × 10.5–16.5 cm*, base cuneate, decurrent, apex acuminate, rounded or emarginate; midrib impressed above, prominent below; *lateral veins 18–24 pairs*, ascending at an angle of 55–60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly impressed above, rounded and prominent below; intercostal venation scalariform, prominulous on both sides; petiole 2.5–3.5 cm long, adaxial side grooved on upper part, flat at base. **Inflorescences** axillary, fascicles 3–8-flowered. **Flowers:** pedicel angular, 5–23 mm long, pubescent; sepals lanceolate, *c.* 5 × 2.5 mm, brownish sericeous; corolla lobes 6, lanceolate, 3.5–4 mm long; stamens 12, filaments subulate, *c.* 1 mm long, *anthers* ovoid, 3–4 mm long, *dehiscing laterally*; *ovary subglobose*, *c.* 2 × 1.5 mm, *brownish pubescent*, style subulate, 7–8 mm long, glabrous. **Fruits** *ellipsoid*, *2–3 × 1.5–2 cm*; pericarp fleshy, glabrous. **Seeds** ellipsoid, *c.* 2 × 1.5 cm; scar covering about half of seed surface.

Distribution. Endemic to Borneo. Found in Kuching, Sri Aman, Kapit and Bintulu divisions in Sarawak (e.g., *S 28973*, *S 33131* and *S 49918*) and in C Kalimantan (e.g., *Hallier 357*). Possibly also occurring in Brunei.

Ecology. In lowland mixed dipterocarp forest.

8. **Palaquium edenii** Pierre *ex* Dubard

(Probably named after F.W. van Eeden, 1829–1901, the first Director of the Haarlem Colonial Museum, the Netherlands)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 22; H.J. Lam *l.c.* (1925) 50, *l.c.* (1927) 398; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 499; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150. **Type:** *Beccari PB 361*, Borneo, Sarawak (holotype FI; isotypes G, P).

Tree. **Twigs** subterete, slender, 2–4 mm diameter, brownish hairy. **Terminal buds** to 8 mm long, brownish hairy. **Stipules** lanceolate, 2–3 mm long, brownish pubescent outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, *densely brownish-tomentose below*, especially along midrib; elliptic, *5.5–8 × 2.2–3 cm*, base cuneate, shortly decurrent, apex shortly acuminate with obtuse tip; midrib impressed above, prominent below; *lateral veins 9–10 pairs*, *ascending at an angle of 40–45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; intercostal venation scalariform, distinct below, inconspicuous above; petiole 1.7–2.2 cm long, grooved on adaxial side, round on abaxial side, brownish to greyish tomentose. **Inflorescences** axillary, *fascicles 2–3-flowered*. **Flowers:** pedicel angular, to 10 mm long, brownish tomentose; sepals ovate, *c.* 2.5 × 2 mm, brownish tomentose outside, glabrous inside, basal part of inner sepals with fimbriate margin; corolla lobes 6, 7–10 mm long, narrowly elliptic, glabrous; stamens 10–12, filaments slender, *c.* 5 mm long, anthers oblong or cordate, 1.5–2.5 mm long, brownish hairy on both sides; ovary ovoid, *c.* 2 × 1.5 mm long, 6-loculed, 6-lobed, glabrous, style slender, 1–1.5 mm long, glabrous. **Fruits** *ellipsoid*, *c. 1.5 × 1 cm*, apex with short remnant of style, 1-seeded; pericarp fleshy, glabrous.

Distribution. Endemic to Borneo. Known only by the type collection from Sarawak (*Beccari PB 361*).

Ecology. In mixed dipterocarp forest.

9. **Palaquium elegans** Griffioen & H.J.Lam

(Latin, *elegans* = elegant; the habit)

In P. Royen *l.c.* (1960) 465; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323. **Type:** *Haviland 898/801*, Borneo, Sarawak, Rejang, Sibu (holotype L; isotype SAR).

Tree to 24 m tall. **Twigs** slender, *c.* 2.5 mm diameter, *brownish pubescent*, glabrescent. **Terminal buds** *c.* 3.5 mm long, brownish puberulous. **Stipules** lanceolate, *c.* 2.5 × 0.5 mm, pubescent on both sides, caducous. **Leaves** *clustered at ends of twigs*, thinly coriaceous, *glabrous on both surfaces*; *elliptic*, 14–17.5 × 4.5–6 cm, base rounded-acute, apex acuminate; midrib impressed above, prominent below; *lateral veins 17–20 pairs*, ascending at an angle of 45–55° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, indistinct above, prominent below;

intercostal venation scalariform, inconspicuous on both sides; petiole thick, 0.4–0.7 cm long, flat on adaxial side, brownish tomentose. **Inflorescences** axillary, fascicles *c.* 10-flowered. **Flowers:** *pedicel* angular, *18–21.5 mm long*, brownish tomentose; sepals ovate, *c.* 4.5 × 2 mm, brownish tomentose outside, glabrous inside, inner sepals with irregular margin; corolla lobes 6, ovate-lanceolate, 8.5–10 mm long; stamens 12, filament subulate, *c.* 1 mm long, anthers ovoid-oblong, *c.* 3 mm long, glabrous, outer ones dehiscing extrorsely, inner ones introrsely; ovary globose, *c.* 1.5 mm diameter, brownish tomentose, style, slender, *c.* 10 mm long, glabrous. **Fruits** *ovoid*, 1.4–1.8 × 0.9–1.3 cm; pericarp thin, glabrous. **Seeds** unknown.

Distribution. Endemic to Borneo. Known from Sarawak by few collections from Rejang in Sibu (the type), Bt. Mersing in Bintulu Division and Lambir NP in Miri Division.

Ecology. In mixed dipterocarp forest.

10. **Palaquium ferrugineum** Pierre *ex* Dubard

(Latin, *ferrugineus* = rusty coloured; the indumentum)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 11; H.J. Lam *l.c.* (1925) 71, *l.c.* (1927) 402; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 561; Whitmore, Tantra & Sutisna *l.c.* 323. **Type:** *Beccari PB 2283*, Borneo, Sarawak, near Matang (holotype P; isotypes FI, G, L).

Large tree. **Twigs** slender, 1.5–5 mm diameter, *angular*, *reddish-brown tomentose*, glabrescent. **Terminal buds** *8–10 mm long*, brownish tomentose. **Stipules** *lanceolate*, *c. 4 × 2.5 mm*, brownish tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, sparsely brownish-tomentose above, *densely reddish-brown tomentose below*; elliptic, *5–9.5 × 2.5–4 cm*, base narrowly cuneate, decurrent, apex obtusely acuminate; midrib impressed above, prominent below; *lateral veins 12–15 pairs*, *ascending at an angle of 30–40° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed but rather insconspicuous above, prominent below; intercostal venation scalariform, inconspicuous on both sides; *petiole grooved on adaxial side*, *reddish-brown tomentose*. **Inflorescences** *borne in axils of leaf scars*, fascicles 2–6-flowered. **Flowers:** *pedicel* angular, *c.* 5 mm long, *brownish tomentose*; sepals ovate, *c.* 2 × 1.5 mm, brownish tomentose outside, glabrous inside, inner sepals smaller; corolla lobes elliptic-lanceolate, glabrous, reflexed at anthesis; stamens 12, filaments slender, 2.5–3.5 mm long, glabrous, *anthers ovoid-oblong*, brownish hairy, *dehiscing laterally* or *subextrorsely*; ovary discoid, *c.* 1.5 × 1 mm, 6-loculed, brownish tomentose, style subulate, *c.* 7 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and known only by the type specimen from Matang, Sarawak (*Beccari PB 2283*).

Ecology. In mixed dipterocarp forest.

11. **Palaquium gutta** (Hook.*f.*) Baill.

(Englishised Malay word—*getah* = sap or latex; referring to the tree as a source of gutta-percha latex)

Tr. Bot. Méd, Phan. (1884) 1500; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 24; King & Gamble *l.c.* 192; Merrill *l.c.* (1921) 480; Ridley *l.c.* (1923) 274; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; P. Royen *l.c.* (1960) 553; Ng *l.c.* 420; Anderson *l.c.* 317; Corner *l.c.* 695; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150; Turner, Gard. Bull. Sing. 47 (1995) 465; Argent *et al.* (eds.) *l.c.* 583. **Basionym:** *Isonandra gutta* Hook.*f.*, Lond. J. Bot. 6 (1847) 463. **Lectotype** (P. Royen, 1960)**:** *Lobb 290*, Singapore (holotype K; isotype SING). **Synonyms:** *Dichopsis gutta* (Hook.*f.*) Benth. & Hook.*f.*, Gen. Pl. 2 (1876) 658; *Croixia gutta* (Hook.*f.*) Baehni *l.c.* 110; *Palaquium borneense* Pierre, Bull. Soc. Lin., Paris 1 (1883) 496; *P. gutta* (Hook.*f.*) Baill. forma *borneense* (Pierre) H.J.Lam *l.c.* (1925) 28; *P. oblongifolium* Burck *l.c.* 25; *P. fulvosericeum* Engl., Bot. Jahrb. Syst. 12 (1890) 511; *P. ellipsoideum* Becc., Nelle For. Born. ed. 1 (1902) 560; *P. magnoliaefolium* Becc. *l.c.* 560; *P. optimum* Becc. *l.c.* 559; *P. tammedak* Becc. *l.c.* 559; *P. sambasense* Pierre *ex* Dubard *l.c.* 11.

Tree to 40 m tall. **Bark** reddish brown, cracked or fissured, inner bark greenish white to yellowish green. **Twigs** slender, 2–5 mm diameter, subterete or angular, *covered with prominent leaf scars*, usually *golden tomentose* or glabrescent. **Terminal buds** *to 6 mm long*, *brownish tomentose*. **Stipules** *lanceolate*, *to 3 mm long*, brownish tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs* or *clustered near ends of twigs*, *coriaceous*, puberulous to glabrous above, *densely golden tomentose below*; elliptic-oblong, broadly oblong or obovate, *9.5–13 × 3–8 cm*, base broadly or narrowly cuneate, decurrent, apex rounded to acuminate; midrib impressed above, prominent below; *lateral veins 13–27 pairs*, *ascending at an angle of 75–85° from midrib*, *arching and joining into intramarginal veins along leaf margin*, prominulous or almost inconspicuous above, prominent below; *intercostal venation scalariform*, subparallel or sometimes reticulate, prominent or inconspicuous on both sides, or more prominent below; petiole 1–4 cm long, grooved on adaxial side, golden to brownish tomentose. **Inflorescences** *axillary*, *fascicles 2–12-flowered*. **Flowers:** *pedicel* angular, *3–15 mm long*, sericeous to golden tomentose; outer sepals ovate, 2–3 × 3–7 mm, inner sepals ovate-oblong, golden tomentose outside, glabrous inside; *corolla to 2 mm long*, lobes elliptic-ovate; *stamens 12*, filaments lanceolate, to 6 mm long, glabrous, *anthers narrowly ovoid* or *sagittate*, 2–2.5 mm long, glabrous, dehiscing extrorsely; *ovary ovoid*, *c.* 1.5 mm across, 6-loculed, *brownish tomentose*, style slender, 6–9 mm long, pubescent. **Fruits** *globose* or *depressed ellipsoid*, 1–2.5 × 2–2.5 cm, 1–2-seeded; pericarp thin or fleshy, brownish tomentose or glabrescent. **Seeds** ovoid to ellipsoid, *c.* 2 × 1 cm; scar covering about half of seed surface.

Vernacular names. Sabah—*nyatoh taban merah* (Malay). Sarawak—*nyatoh rian* (Iban, Malay). Brunei—*jangkar* (Iban), *jangkar merah* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Fairly common throughout Sabah (e.g., *Clemens 21232*, *Clemens 50695*, *SAN 10230*, *SAN 55176*, and *SAN A 16816*) and Sarawak (*Beccari PB 2269*, *Danyut A 1274*, *Egon 612*, *S 32262*, and *S 33480*). Also widespread in Brunei and Kalimantan (e.g., *bb. 12644*, *bb. 20444*, *bb. 21211*, and *bb. 29676*).

Ecology. Frequent in mixed dipterocarp forest, *kerangas* and limestone forests.

Taxonomy. *P. gutta* is a highly variable species. However, H.J. Lam's contention (*l.c.* 1925) to recognise 4 distinct forms, *viz.* f. *gutta*, f. *borneense*, f. *selendit*, and f. *vrieseanum*, is not endorsed in the present account.

Uses. Well known for its commercial gutta-percha latex.

12. **Palaquium herveyi** King & Gamble

(D.F.A. Hervey, 1849–1911, former Resident of Malacca, Peninsular Malaysia)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 197; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 38, *l.c.* (1927) 395; Wyatt-Smith, FRI Res. Pamphl. 4 (1954) 35; P. Royen *l.c.* (1960) 489; Ng *l.c.* 420; Coode *et al.* (eds.) *l.c.* 307; Turner *l.c.* 465. **Type:** *Hervey s.n.*, Peninsular Malaysia, Malacca (holotype K).

Tree to 45 m tall. **Bark** reddish brown, flaky; inner bark laminated, reddish to orange-brown. **Twigs** slender, *c.* 2.5 mm diameter, angular, brownish to greyish pubescent, glabrescent. **Terminal buds** to 4 mm long, puberulous. **Stipules** lanceolate, *c.* 4 × 2 mm, brownish tomentose outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, subcoriaceous, *sparsely greyish-hairy on both surfaces*, glabrescent below; *broadly obovate*, *3–7.5 × 2–5 cm*, base cuneate, apex acuminate; midrib crested or impressed above, angular to round below; *lateral veins* 5–10 pairs, *ascending at an angle of 40–45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, rounded below; *intercostal venation* fine, scalarifom, *inconspicuous on both sides*; *petiole* 0.8–1.5 cm long, *crested* or *flat on adaxial side*, rounded on abaxial side, brownish or greyish pubescent. **Inflorescences** axillary, fascicles 2–6-flowered. **Flowers:** pedicel angular, brownish tomentose; outer sepals ovate, *c.* 2.5 × 2 mm, apex subobtuse, brownish tomentose outside, glabrous inside, inner sepals lanceolate, margin pubescent with stiff hairs; corolla 4–5 mm long, brownish hairy, lobes oblong-ovate, apex rounded; stamens 12, filaments slender, 1–2 mm long, glabrous, anthers ovoid-oblong, *c.* 1.5 mm long, brownish hairy, dehiscing extrorsely; *ovary* subglobose, *c.* 1 × 0.7 mm, *sparsely tomentose*, style subulate, 5–8 mm long, glabrous. **Fruits** *ellipsoid*, *1–1.4 × 0.7–1 cm*, *1-seeded*, glabrous. **Seeds** fusiform, *c.* 0.8 × 0.3 cm; scar covering more than half of seed surface.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from the southwestern part of Sabah (e.g., *SAN 16775*, *SAN 21071* and *SAN 28333*) and from Brunei (e.g., *Aziz 363*, *BRUN 2607* and *SAN 17076*).

Ecology. In mixed dipterocarp forest.

13. **Palaquium hexandrum** (Griff.) Baill.

(Latin, *hexandrum* = with six stamens; the flowers)

Tr. Bot. Méd. Phan. (1884) 1500; King & Gamble *l.c.* 197; Ridley *l.c.* (1923) 277; H.J. Lam *l.c.* (1927) 409; Wyatt-Smith *l.c.* (1954) 34; P. Royen *l.c.* (1960) 501; Ng *l.c.* 421; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 151; Turner *l.c.* 466; Argent *et al.* (eds.) *l.c.* 584. **Basionym:** *Isonandra hexandra* Griff., Not. Pl. As. 4 (1851) 292. **Type:** *Griffith 3609*, Peninsular Malaysia, Malacca, Nanguli (holotype K; isotype L). **Synonyms:** *Dichopsis hexandra* (Griff.) C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 543; *Croixia hexandra* (Griff.) Baehni *l.c.* 111; *Palaquium pisang* Burck *l.c.* (1886) 41.

Tree to 50 m tall, 120 cm diameter; buttresses to 3 m high. **Bark** dark brown; inner bark reddish brown. **Twigs** slender, 2–3.5 mm diameter, angular or subterete, brownish puberulous, glabrescent. **Terminal buds** 5–8 mm long, puberulous. **Stipules** lanceolate or ovate, *c.* 2.5 × 1 mm, puberulous outside, glabrous inside, persistent or caducous. **Leaves** *clustered at ends of twigs*, *chartaceous* to *subcoriaceous*, glabrous above, *densely brownish-puberulous below*; ovate to oblong-ovate, *7–11 × 2.5–4 cm*, base broadly to narrowly cuneate, apex acute or acuminate; midrib impressed above, rounded below; *lateral veins 6–11 pairs*, *ascending at an angle of 60–70° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominulous to inconspicuous on both sides; intercostal venation finely scalariform, conspicuous to inconspicuous on both sides; petiole slender, 0.5–2.5 cm long, grooved on adaxial side, rounded on abaxial side, brownish puberulous, glabrescent. **Inflorescences** axillary, *fascicles to 18-flowered*. **Flowers:** pedicel angular, to 12 mm long, brownish sericeous; outer sepals triangular to deltoid, *c.* 2.5 × 2 mm, brownish puberulous outside, glabrous inside, inner sepals with hairy margin; corolla lobes elliptic-oblong or lanceolate, *c.* 7 mm long, with hairy margin; stamens 12, filaments subulate, 2–2.5 mm long, anthers elliptic-oblong, 2–2.5 mm long, bifid at apex, glabrous, dehiscing extrorsely; ovary ovoid, *c.* 1 × 0.5 mm, 6-loculed, glabrous, style slender, 6–12 mm long, glabrous. **Fruits** *globose* or *ovoid*, *2–3 × 1.5–2 cm*, 1–2-seeded; pericarp fleshy, glabrous. **Seeds** ovoid, *c.* 2.5 × 1.5 cm; scar covering about half of seed surface.

Distribution. Sumatra, Peninsular Malaysia and Borneo. Rare in Sabah (e.g., *SAN 16812*) and Sarawak (e.g., *S 0676* and *S 0877*), more common in E Kalimantan (e.g., *bb. 26431*, *bb. 31623*, *bb. 34706*, *Kostermans 5309*, and *Kostermans 5509*). Also occurs in Brunei.

Ecology. In lowland forest. In Kalimantan, frequent in alluvial forest along riverbanks.

Uses. One of the large species which is useful for its light-weight timber. The sour fruit is said to be edible and the seeds produce a fat which is considered one of the most important sources of vegetable fat in Siak, Sumatra.

14. **Palaquium hispidum** H.J.Lam

(Latin, *hispidus* = covered with coarse rigid erect hairs; the twigs, terminal buds, under side of leaves and inflorescences)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 63, *l.c.* (1927) 400; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 460; Ng *l.c.* 421; Whitmore, Tantra & Sutisna *l.c.* 323; Turner *l.c.* 466. **Type:** *van Delden s.n.*, Peninsular Malaysia, Pahang, Kuala Lipis (holotype L; isotype BO). **Synonyms:** *Palaquium hispidum* H.J.Lam var. *typicum* and var. *grandiflorum* H.J.Lam *l.c.* (1925) 64; *Croixia hispida* (H.J.Lam) Baehni *l.c.* 111.

Tree to 50 m tall. **Bark** greyish white, inner bark reddish. **Twigs** stout, 5–8 mm diameter, subterete, *brownish pubescent with hirsute hairs*, glabrescent. **Terminal buds**, *c. 15 mm long*, hirsute pubescent. **Stipules** lanceolate, *c.* 13 × 5 mm, brownish hirsute-pubescent outside. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, *densely brownish* or *yellowish hirsute-pubescent below*; ovate or ovate-oblong, *14–25 × 6–10 cm*, base cuneate or rounded, apex acuminate; midrib impressed above, rounded and prominent below; *lateral veins 19–30 pairs*, *ascending at an angle of to 50° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; intercostal venation finely scalariform, indistinct above, slightly distinct below; *petiole to 0.5 cm long*, grooved on adaxial side. **Inflorescences** axillary, fascicles 3–8-flowered. **Flowers:** *pedicel to 5 mm long*, densely hirsute-pubescent; outer sepals ovate or triangular, 5–8 × 3–10 mm, apex obtuse or rounded, brownish pubescent outside, glabrous inside, inner sepals with filmy and fimbriate margins; corolla 10–15 mm long, glabrous except for the hairy base, 6-lobed; stamens 12, glabrous, filaments slender, 2–3 mm long, angular; anthers oblong, 3–3.5 mm long, apex bifid, dehiscing extrorsely; ovary ovoid, *c.* 2.5 × 2 mm, 6-loculed, hirsute, style slender, to 10 mm long, angular, glabrous. **Fruits** *subglobose*, *1.8–2.4 × 1.4–1.8 cm*, usually 1-seeded, with remnant of style, glabrous. **Seeds** ovoid, *c.* 1.4 × 1 cm; scar covering about one third of seed surface.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo rare, recorded from Baram, Bintulu, and Pelagus districts in Sarawak (e.g., *S 41325*) and from Kalimantan (e.g., *Church & Mahyar 2005*).

Ecology. In lowland mixed dipterocarp forest.

15. **Palaquium kinabaluense** P.Royen

(of Mt. Kinabalu, Sabah)

Blumea 10 (1960) 475; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 324. **Type:** *Clemens 27635*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype L; isotypes BM, CAL, G, SING). **Synonym:** *Palaquium macrocarpum auct. non* Burck: Anderson *l.c.* 317.

Tree to 20 m tall. **Bark** pinkish green; inner bark whitish. **Twigs** stout, 5–7 mm diameter, woolly tomentose. **Terminal buds** *to 10 mm long*, woolly tomentose. **Stipules** oblong-ovate, *c. 7 × 3.5 mm*, brownish tomentose outside, glabrous inside, caducous. **Leaves** *clustered at end of twigs*, *coriaceous*, whitish tomentose above, *densely yellowish-tomentose below*, glabrescent; obovate, *12–34 × 6–15 cm*, base broadly cuneate, apex rounded or acuminate; midrib slightly impressed above, flattened or rounded and prominent below; *lateral veins 15–16 pairs*, ascending at an angle of 50–60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* finely scalariform, *prominulous on both sides*; *petiole 1.5–3.5 cm long*, grooved on adaxial side, rounded on abaxial side, brownish tomentose. **Inflorescences** axillary, fascicles 2–8-flowered. **Flowers:** *pedicel* terete, *to 4 mm long*, brownish woolly-tomentose; outer sepals triangular, 2–4 × 1.5–2 mm, woolly tomentose outside, glabrous inside, inner sepals with glabrous and membranous margin; corolla lobes ovate-lanceolate, to 8 mm long; stamens 12, filaments subulate, *c.* 1 mm long, *anthers lanceolate-oblong*, *c.* 2.5 mm long, dehiscing extrorsely; *ovary* obovoid, *c.* 1 × 1.5 mm, 6-loculed, *glabrous* except for the slightly hairy apex, style stout, conoid, *c.* 5 mm long, glabrous. **Fruit** *ovoid*, *c. 1 × 0.6 cm*, 1-seeded, glabrous. **Seeds** unknown.

Distribution. Endemic to Borneo. Recorded from Mt. Kinabalu and Sandakan district in Sabah (e.g., *Clemens 27635*) and G. Mulu NP, Miri division and Rejang River in Sibu division in Sarawak (e.g., *Clemens 21532* and *Clemens 21824*).

Ecology. In lowland and hill mixed dipterocarp forests, including limestone forest, at altitudes to 1000 m.

16. **Palaquium leiocarpum** Boerlage

(Greek, *leios* = smooth to the touch, *karpos* = fruit; with smooth fruit)

Bull. Inst. Bot. Buitenz. 5 (1900) 24; Merrill *l.c.* (1921) 480; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 514; Ng *l.c.* 422; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 324; Pennington *l.c.* 151; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 584. **Lectotype** (P. Royen, 1960)**:** *Romburgh 2*, Borneo, Kalimantan (hololectotype BO). **Synonym:** *Palaquium molle* Pierre *in* Beccari, Nelle For. Born. ed. 1 (1902) 559, H.J. Lam *l.c.* (1925) 105, *l.c.* (1927) 413.

Tree to 30 m tall. **Bark** brownish to reddish grey, finely fissured; inner bark light brown, soft. **Twigs** 2–8 mm diameter, terete, brownish tomentose, with scattered leaf scars. **Terminal buds** *to 8 mm long*. **Stipules** ovate or lanceolate, *c. 5 × 3.5 mm*, tomentose outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, usually dark brown when dry, *densely rusty-brown tomentose below*; oblong or obovate, *10–17 × 5.5–12 cm*, base cuneate, margin revolute, apex rounded or acuminate; midrib impressed and faintly crested above; *lateral veins 13–23 pairs*, ascending at an angle of 45–65° from midrib, mostly *diminishing and becoming inconspicuous toward leaf margin* or rarely arching and joining into intramarginal veins along leaf margin; *intercostal venation* scalariform or reticulate, *inconspicuous above*, prominent below; *petiole 1.5–5 cm long*, slightly thickened at base, brownish tomentose. **Inflorescences** axillary, fascicles 3–6-flowered. **Flowers:** *pedicel 8–18 mm long*, tomentose; outer sepals triangular or ovate, 5.5–8 × 4–4.5 mm, apex acute or obtuse, brownish tomentose, inner sepals smaller, apex almost rounded, glabrous; corolla to 10 mm long, lobes lanceolate, sparsely hairy; stamens 12, filaments slender, *c.* 3.5 mm long, *anthers sagittate*, *c.* 4 mm long, tomentose, dehiscing introrsely; *ovary* ovoid, *c.* 1 × 1 mm, 6-lobed, 6-loculed, *brownish tomentose*, style slender, *c.* 12 mm long. **Fruits** *ellipsoid* or *globose*, *1–3 × 1–2.5 cm*, with persistent style or its remnant. **Seed** ellipsoid, 1–1.4 × 0.8–1.2 cm; scar covering about half of seed surface.

Vernacular name. Sarawak—*nyatoh tembaga* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and Sulawesi. Common in most parts of Sabah (e.g., *SAN A 4565* and *SAN 16694*) and Sarawak (e.g., *Egon A 0925*, *Nooteboom & Chai 2230*, *S 24579*, *S 38170*, and *S 64091*) as well as in Brunei (e.g., *BRUN 149*, *KEP 32571* and *Wong WKM 1910*), and in Kalimantan (e.g., *van Balgooy & van Setten 5574*).

Ecology. In mixed swamp forest, mixed dipterocarp forest and *kerangas* forest.

Uses. The latex is inferior to gutta-percha, and has consequently been used as an adulterant.

17. **Palaquium lisophyllum** Pierre *ex* Dubard

(Greek, *lisos* = smooth, *phullon* = leaf; with smooth leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 7; Merrill *l.c.* (1921) 480; H.J. Lam, *l.c.* (1925) 73, *l.c.* (1927) 403; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 496; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 324. **Type:** *Beccari PB 3286*, Borneo, Sarawak, Marop (holotype FI; isotype L).

Tree to 20 m tall. **Twigs** slender, 2–4 mm diameter, subterete, *brownish pubescent*, glabrescent. **Terminal buds** *to 10 mm long*, *brownish pubescent*. **Stipules** *lanceolate*, *c. 6 × 3 mm*, brownish pubescent, caducous. **Leaves** *well-spaced along twigs*, *chartaceous*, glabrous above, *brownish tomentose below*; oblong-elliptic, *15–19 × 6.5–8.5 cm*, base cuneate or rounded, apex acuminate; midrib slightly raised above, rounded and prominent below, densely tomentose; *lateral veins 12–14 pairs*, *ascending at an angle of 55–65° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominulous above, prominent below; *intercostal venation* finely scalariform, fairly *conspicuous on both sides*; *petiole 1–1.2 cm long*, *flat and crested on adaxial side*, *brownish puberulous*. **Inflorescences** axillary, fascicles 2–4-flowered. **Flowers:** pedicel 2–3.5 mm long, *brownish puberulous*; outer sepals ovate, *c.* 5 × 3 mm, brownish puberulous outside, glabrous inside, inner sepals with hairy margin; corolla lobes elliptic, *c.* 5 mm long; stamens 12, filaments stout, *c.* 0.5 mm long, *anthers sagittate*, *c.* 2 mm long, acute or bifid, brownish tomentose, dehiscing extrorsely; ovary obovoid, *c.* 1.5 × 1 mm, 6-loculed, glabrous except at apex, style subulate, *c.* 4 mm long, brownish puberulous. **Fruit** unknown.

Distribution. Endemic to Borneo. Uncommon, known only by a single collection (*Beccari PB 3286*) from Matang in southwestern part of Sarawak, and by another collection (*SAN 73554*) from Lahad Datu district in Sabah.

Ecology. In mixed dipterocarp forest.

18. **Palaquium maingayi** (C.B.Clarke) Engl.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca)

Bot. Jahrb. Syst. 12 (1890) 511; King & Gamble *l.c.* 191; Dubard *l.c.* (1909) 7; Ridley *l.c.* (1923) 273; H.J. Lam *l.c.* (1925) 72, *l.c.* (1927) 402; Wyatt-Smith *l.c.* (1954) 36; P. Royen *l.c.* (1960) 482; Ng *l.c.* 423; Pennington *l.c.* 151; Turner *l.c.* 466. **Basionym:** *Dichopsis maingayi* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 543. **Type:** *Maingay 996/2*, Peninsular Malaysia, Malacca (holotype K; isotype L).

Tree to 24 m tall. **Twigs** stout, 6–10 mm diameter, subterete, *brownish woolly-tomentose*, *glabrescent*. **Terminal buds** *to 20 mm long*, densely tomentose. **Stipules** lanceolate, *c.* 10 × 3.5 mm, densely tomentose outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, *densely reddish* to *dark-brownish tomentose below*; obovate to spathulate, *16–24 × 8.5–15 cm*, base acute to rounded, decurrent; midrib impressed above, prominent and rounded below; *lateral veins 12–22 pairs*, *ascending at an angle of 50–60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; *intercostal venation* finely scalariform, *prominent on both sides*; *petiole to 5 cm long*, grooved on adaxial side especially at upper part, thickened at base, *brownish woolly-tomentose*. **Inflorescences** axillary, fascicles 5–10-flowered. **Flowers:** *pedicel* angular, *7–11 mm long*, densely tomentose; outer sepals ovate, 2.5–4 × 2.5–4.5 mm, apex acute, brownish tomentose outside, glabrous inside, inner sepals with rounded apex, margin entire and membranaceous; *corolla to 12 mm long*, glabrous; stamens 12, glabrous, filaments slender, 3–3.5 mm long, *anthers sagittate*, 3–3.5 mm long, dehiscing extrorsely; *ovary discoid*, *c.* 1 × 2 mm, 6-loculed, *glabrous*, style slender, 6–8 mm long, glabrous. **Fruits** *ellipsoid* or *globose*, *c. 3.5 × 2.5 cm*, 1-seeded, glabrous. **Seeds** obovoid, *c.* 2 × 0.5 cm; scar covering about half of seed surface.

Distribution. Peninsular Malaysia and Borneo. A new record for Borneo (Sarawak, e.g., *S 39972*).

Ecology. Riparian and *kerangas* forests.

Uses. The latex was once used as an adulterant to gutta-percha. The heavy dark brown timber is used in house building.

19. **Palaquium majas** H.J.Lam

(Dayak, *majas* = the Bornean *orang utan*; referring to the brownish indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 66, *l.c.* (1927) 401; Masamune *l.c.* 595; P. Royen *l.c.* (1960) 470; Whitmore, Tantra & Sutisna *l.c.* 324; Argent *et al.* (eds.) *l.c.* 584. **Type:** *Jaheri 1085*, Borneo, Kalimantan, Sg. Brunei (holotype BO; isotype L). **Synonym:** *Croixia majas* (H.J.Lam) Baehni *l.c.* 110.

Tree to 24 m. **Bark** brown, flaky. **Twigs** slender, 3–5 mm diameter, terete, *densely brownish woolly-pubescent*, glabrescent, *not covered with prominent leaf scars*. **Terminal buds** *to 10 mm long*, *densely woolly-pubescent*. **Stipules** *ovate*, 5 × 2–4 mm, brownish woolly-pubescent outside, glabrous inside. **Leaves** *well-spaced along twigs*, *chartaceous*, glabrous above, *densely brownish woolly-pubescent below* especially along midrib and veins; obovate, 14–25.5 × 7.5–12.5 cm; midrib impressed above, round and prominent below; *lateral veins 12–14 pairs*, ascending at an angle of 60–65° from midrib, *arching and joining into intramarginal vein along leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, prominent on both sides; petiole 1–2 cm long, thickened, brownish woolly-pubescent. **Inflorescences** axillary, fascicles to 8-flowered. **Flowers:** pedicels angular, 5–12 mm long, brownish woolly-pubescent; outer sepals lanceolate, 4.5–5.5 × 2–3 mm, brownish woolly-pubescent outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes elliptic-oblong, to 10 mm long, glabrous; *stamens 18*, glabrous, filaments slender, 1.5–2 mm long, *anthers oblong*, 3–3.5 mm long, apex bifid, dehiscing laterally; ovary depressed ovoid, *c.* 1.5 × 2 mm, brownish pubescent, 6-loculed, 6-lobed, style slender, *c.* 10 mm long, glabrous. **Fruits** *globose* or *ellipsoid*, 1.5–2 × 1.5–2 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** ellipsoid *c.* 1.5 × 1.2 cm; scar covering about half of seed surface.

Distribution. Endemic to Borneo. Recorded from Engkilili, Sri Aman division and a few localities in Kapit Division in Sarawak (e.g., *S 40541* and *S 48673*). Also found in Kalimantan (e.g., *Jaheri 1054*).

Ecology. In lowland mixed dipterocarp forest on rich yellow soils, at altitudes to 550 m.

20. **Palaquium microphyllum** King & Gamble

(Greek, *mikro* = small, *phullon* = leaf; with small leaves)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 196; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 36, *l.c.* (1927) 395; Masamune *l.c.* 595; Wyatt-Smith *l.c.* (1954) 37; P. Royen *l.c.* (1960) 578; Ng *l.c.* 423; Whitmore, Tantra & Sutisna *l.c.* 324; Pennington *l.c.* 151; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307. **Type:** *Ridley 10840*, Singapore, Bt. Timah (holotype SING).

Tree to 30 m tall. **Bark** dark reddish brown, cracked, slightly flaky. **Twigs** slender, 2.5–5 mm diameter, *reddish woolly-tomentose*, glabrescent, *not covered with prominent leaf scars*. **Terminal buds** to 9 mm long, reddish woolly-tomentose. **Stipules** absent. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *coriaceous*, *glabrous above*, *brownish tomentose below*; spathulate, 3–7 × 2–3.5 cm, base cuneate, apex acuminate; midrib crested and angular above, prominent below; *lateral veins* 8–18 pairs, ascending at an angle of 65–70° from midrib, *arching and joining into intramarginal vein along leaf margin*, conspicuous on both sides; *intercostal venation finely reticulate* or *descending from leaf margin and parallel to lateral veins*; petiole 1–2 cm long, flat or grooved and crested on adaxial side, reddish or greyish woolly-tomentose. **Inflorescences** axillary, fascicles to 4-flowered. **Flowers:** pedicel *c.* 6 mm long, brownish tomentose; outer sepals ovate, *c.* 2.5 × 2 mm, brownish tomentose outside, glabrous inside, with entire margin; corolla lobes elliptic, 4.5–6 mm long, apex obtuse; stamens 12, filaments slender, 2–2.5 mm long, anthers ovoid, 1.5–2 mm long, apex mucronate, glabrous, dehiscing introrsely; ovary conical, *c.* 2 mm across, 6-loculed, 6-lobed, brownish tomentose, style slender, to 8 mm long, glabrous. **Fruits** *globose*, *c. 2.5 cm diameter*, glabrous, with remnant of style. **Seeds** ellipsoid *c.* 2 × 1.5 cm; scar covering about half of seed surface.

Vernacular name. Peninsular Malaysia—*nyatoh pipit* (Malay).

Distribution. Sumatra (including Lingga, Riau, Bangka), Peninsular Malaysia, Singapore, and Borneo. In Sabah, known by several collections from Sandakan district (e.g., *SAN 10676* and *SAN 50358*). In Sarawak, found in Ulu Balleh, Kapit. Also occurs in Seria, Brunei (e.g., *S 5886*).

Ecology. In lowland mixed dipterocarp, swamp, and *kerangas* forests.

Uses. The hard timber is used for planks, posts and other parts of traditional Malay wooden houses.

21. **Palaquium multiflorum** Pierre *ex* Dubard

(Latin, *multi-* = many; *florum* = flower; with many flowers, the inflorescences)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 23; Merrill *l.c.* (1921) 480; H.J. Lam *l.c.* (1925) 91, *l.c.* (1927) 410; Masamune *l.c.* 595; Jeuken, Blumea 6 (1952) 579; P. Royen *l.c.* (1960) 491; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 324; Pennington *l.c.* 152 (as a doubtful species). **Type:** *Beccari PB 1439*, Borneo, Sarawak, Matang (holotype P; isotypes FI, G, L, NY, SING). **Synonym:** *Isonandra emarginata* H.J.Lam *l.c.* (1927) 420, Jeuken *l.c.* 578.

Small tree to 8 m tall. **Bark** finely fissured, reddish brown; inner bark light brown, laminated. **Twigs** slender, 1.5–3 mm diameter, angular, brownish tomentose, glabrescent. **Terminal buds** *to 4 mm long*, brownish tomentose. **Stipules** *triangular-lanceolate*, *c.* 1.5 × 1 mm, apex acute, tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; elliptic to obovate, 3–6.5 × 1.8–4.5 cm, base broadly cuneate, apex rounded; midrib crested above, rounded and prominent below; *lateral veins 5–8 pairs*, ascending at an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, *prominulous on both sides*; *intercostal venation* finely scalariform, *insconpicuous below*; *petiole* slender, 0.3–0.4 cm long, flat or grooved on adaxial side, *greyish tomentose*, glabrescent. **Inflorescences** terminal or axillary, fascicles 3–7-flowered. **Flowers:** pedicel angular, 5–14 mm long, brownish tomentose; outer sepals 5–6, ovate, *c.* 2.5 × 2 mm, brownish tomentose outside, whitish tomentose inside, inner sepals with membranaceous margin, nearly glabrous; corolla lobes ovate-elliptic, *c.* 4 mm long, glabrous on both sides; stamens 9–13, filament subulate, *c.* 1 mm long, *anthers sagittate*, *c.* 0.6 mm long, apex rounded or truncate, *tomentose*; ovary ellipsoid, *c.* 1.5 × 1 mm, 11–13-loculed, tomentose, style subulate, 1–1.5 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and confined to the southwestern part of Sarawak (e.g., *Beccari PB 1439* and *Haviland 1890*).

Ecology. Mostly in *kerangas* forest, rarely in mixed dipterocarp forest.

22. **Palaquium obovatum** (Griff.) Engl.

(Latin, *obovatum* = obovate; shape of the leaves)

Bot. Jahrb. Syst. 12 (1890) 511; King & Gamble *l.c.* (1906) 190; Dubard, Bull. Bot. Soc. Fr. 56, Mém. 16 (1909) 5, Bull. Mus. Hist. Nat., Paris 15 (1909) 380; Ridley *l.c.* (1923) 273; H.J. Lam *l.c.* (1925) 83; *l.c.* (1927) 408; Masamune *l.c.* 595; Wyatt-Smith *l.c.* (1954) 38; P. Royen *l.c.* (1960) 453; Ng *l.c.* 423; Anderson *l.c.* 318; Corner *l.c.* 695; Pennington *l.c.* 151; Turner *l.c.* 466. **Basionym:** *Isonandra obovata* Griff., Not. Pl. As. 4 (1854) 293. **Type:** *Griffith 3606*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Dichopsis obovata* (Griff.) C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 542; *Palaquium theoideum* Elmer, Leafl. Philip. Bot. 3 (1910) 868; *P. punctatum* Fletcher, Kew Bull. (1937) 375.

Tree to 40 m tall. **Bark** red-brown, fissured and scaly, inner bark red to pale yellow. **Twigs** slender, 3–6 mm diameter, angular, generally brownish tomentose, glabrescent. **Terminal buds** *to 20 mm long*, tomentose. **Stipules** lanceolate to linear, *c.* 4.5 × 1.5 mm, pubescent outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *chartaceous* to *subcoriaceous*, glabrous above, *densely tomentose below*; obovate, obovate-oblong, or oblong, *14–30 × 8–12 cm*, base cuneate, apex obtuse or rounded to obtusely acuminate; midrib impressed and crested above, rounded and prominent below, characteristically dark brown in dried specimens; *lateral veins 10–18 pairs*, ascending at an angle of 45–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, conspicuous above, rounded and prominent below; intercostal venation finely scalariform, distinct on both sides; petiole 1–4.5 cm long, grooved or flat on adaxial side, tomentose to glabrous. **Inflorescences** axillary, fascicles 7–10-flowered. **Flowers:** pedicel angular, 10–20 mm long, brownish tomentose; outer sepals triangular, *c.* 3 × 2.5 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes lanceolate-oblong, 6–15 × 2.5–3.5 mm long, tomentose, soon becoming glabrous; stamens 12, filaments slender, 4–5 mm long, glabrous, *anthers* ovoid, *c.* 2.5 mm long, brownish tomentose, *dehiscing extrorsely*; *ovary conical*, *c.* 3 × 2 mm, *glabrous*, style, slender, 2–2.5 mm long, glabrous. **Fruits** *globose*, *c. 2.5–3 cm diameter*, glabrous, 1–2-seeded; pericarp fleshy, glabrous. **Seeds** compressed ellipsoid, *c.* 2 × 1.8 cm; scar narrow, *c.* 20 × 7 mm.

Distribution. From India to Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, recorded from Bau, Mulu NP and Lambir NP in Sarawak, Penampang district in Sabah and from Kalimantan.

Ecology. Mostly found in limestone forest but also occurs in other types of lowland forest.

Uses. The latex was formerly used as a low quality gutta-percha. Its timber is durable under water and thus useful in boat-planking and house building.

23. **Palaquium ottolanderi** Koord. & Valeton

(T. Ottolander, 1854–1935, Dutch planter in Java)

Bijdr. Booms. Java 1 (1894) 146; H.J. Lam *l.c.* (1925) 64, *l.c.* (1927) 401; P. Royen *l.c.* (1960) 481; Ng. *l.c.* 424; Pennington *l.c.* 151; Turner *l.c.* 466. **Type:** *Koorders 10158ß*, Java, Banjumas, Pelabuhan Ratu (holotype L; isotype BO). **Synonym:** *Croixia ottolanderi* (Koord. & Valeton) Baehni *l.c.* 110.

Tree to 30 m tall. **Twigs** stout, 9–15 mm diameter, covered with numerous leaf scars, *brownish woolly-tomentose*, *glabrescent*. **Terminal buds** *14–18 mm long*. **Stipules** lanceolate, *c.* 15 × 5 mm, acute to acuminate, hairy outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above except for the hirsute midrib, *densely hirsute-pubescent below*, denser along midrib and veins; elliptic, obovate, or oblong, *26–33 × 10.5–16.5 cm*, base broadly cuneate, slightly decurrent, apex rounded or broadly acuminate; midrib impressed above, rounded and prominent below; *lateral veins 14–20 pairs*, *ascending at an angle of 55–65° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, rarely arching and joining into intramarginal vein along leaf margin, impressed above, prominent below; *intercostal venation* scalariform, *inconspicuous above*, *prominent below*; *petiole 2–6 cm long*, flat or shallowly grooved on adaxial side, *glabrous*. **Inflorescences** axillary, fascicles 7–16-flowered. **Flowers:** *pedicel* angular, *8–20 mm long*, brownish hirsute; outer sepals ovate or obovate, 4–7 mm across, brownish hirsute outside, glabrous inside; *corolla 15–20 mm long*, lobes elliptic-oblong, apex obtuse; stamens 12, filaments slender, 3.5–5 mm long, *anthers oblong*, 2–3 mm long, apex mucronate, dehiscing introrsely; *ovary subglobose* to *ovoid*, *c.* 2.5 mm diameter, 6-loculed, 6-lobed, *hirsute*. **Fruits** *ovoid-oblong*, *c. 7 × 3 cm*. **Seeds** fusiform, *c.* 3.5 × 1.5 cm; scar covering about half of seed surface.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, recorded from Sandakan district in Sabah and from C Kutei in Kalimantan.

Ecology. In lowland mixed dipterocarp forest.

Notes. Very close to *Palaquium majas* but differs by its larger leaves.

24. **Palaquium pseudocuneatum** H.J.Lam

(Latin, *pseudo-* = false, somewhat; *cuneatum* = wedge-shaped; the somewhat wedge-shaped leaf base)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 391; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 588; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 324; Coode *et al.* (eds.) *l.c.* 307. **Type:** *Egon 340*, Borneo, Sarawak (holotype BO; isotype SAR). **Synonym:** *Croixia pseudocuneata* (H.J.Lam) Baehni *l.c.* 110.

Tree to 35 m tall. **Bark** reddish to light greyish brown, cracked or narrowly fissured, sometimes flaky, inner bark red or pink, laminated, fibrous. **Twigs** slender, 2–3 mm diameter, terete or angular, *glabrous*, *not covered with prominent leaf scars*. **Terminal buds** 3–6 mm long, tomentose. **Stipules** *small*, *caducous*. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *subcoriaceous*, *glabrous on both surfaces*; obovate or spathulate, 4–9.5 × 2–3.8 cm, base cuneate, *apex acuminate*; midrib impressed above, angular and prominent below; *lateral veins 12–14 pairs*, ascending at an angle of 60–75° from midrib, *arching and joining into intramarginal veins along leaf margin*, prominulous on both sides; *intercostal venation descending from leaf margin and parallel to lateral veins* or *finely reticulate*, slightly conspicuous above, more distinct below; *petiole 0.9–1.5 cm long*, *grooved on adaxial side*, angular on abaxial side, *glabrous*. **Inflorescences** *axillary*, fascicles 2–3-flowered. **Flowers:** *pedicel* angular, *7–12 mm long*, brownish tomentose; outer sepals ovate, *c.* 3 × 2 mm, brownish tomentose outside, glabrous inside, inner sepals smaller; corolla lobes elliptic-oblong, to 4 mm long, brownish woolly-pubescent at base; stamens 12, filaments slender, 1.5–2.5 mm long, densely brownish hairy, anthers ovoid, 1–2 mm long, glabrous, dehiscing extrorsely; *ovary ovoid*, *c.* 2 mm across, brownish hirsute, style slender, 6–10 mm long, glabrous. **Fruits** *ellipsoid*, *2–5 × 1.3–4 cm*, *1-seeded*; pericarp fleshy, glabrous. **Seeds** *obovoid*, *c. 1 × 0.8 cm*; scar covering about half of seed surface.

Vernacular name. Sarawak—*nyatoh babi kecil* (Iban).

Distribution. Endemic to Borneo and recorded from Kuching and Miri divisions in Sarawak (e.g., *Egon A 0937*, *S 4954*, *S 9246*, and *S 9256*), Brunei (e.g., *KEP 35707* and *van Niel 3814*) and Kalimantan (e.g., *bb. 12400* and *bb. 14246*).

Ecology. Mainly in seasonal freshwater swamp forest but also occurs in hill forests.

25. **Palaquium pseudorostratum** H.J.Lam

(Latin, somewhat similar to *P. rostratum*)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 393; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 586; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 151; Argent *et al.* (eds.) *l.c.* 585. **Type:** *bb. 9449*, Borneo, Kalimantan, Tuwanan, Lower Dajak (holotype BO; isotype L). **Synonym:** *Croixia pseudorostrata* (H.J.Lam) Baehni *l.c.* 108.

Tree to 30 m tall. **Bark** reddish brown, shallowly fissured to smooth; inner bark thin, pinkish to reddish brown. **Twigs** stout, 3–7 mm diameter, subterete or angular, *glabrous*. **Terminal buds** 3–6 mm long, brownish sericeous. **Stipules** *small*, *caducous*. **Leaves** *well-spaced along twigs*, *chartaceous* to *subcoriaceous*, *glabrous on both surfaces*; spathulate to obovate, 6.5–14 × 3–6 cm, base narrowly cuneate, *apex rounded* or *obtuse*; midrib impressed and crested above, angular and prominent below; *lateral veins* 12–16(–20) pairs, ascending at an angle of 70–80° from midrib, *arching and joining into intramarginal vein along leaf margin*, prominulous to inconspicuous above, prominulous below; *intercostal venation descending from leaf margin and parallel to lateral veins*, fine, slightly distinct above, prominent to inconspicuous below; *petiole* 0.5–4 cm long, flat or grooved on adaxial side, angular on abaxial side, *brownish tomentose*, glabrescent. **Inflorescences** *axillary*, fascicles 2–4-flowered. **Flowers:** *pedicel* angular, *3–4.5 mm long*, brownish sericeous; outer sepals ovate, 3–5 × 2–3.5 mm, brownish puberulous outside, glabrous inside, inner sepals membranaceous along margin; corolla lobes elliptic-oblong, to 5 mm long; stamens 12, in two whorls, filaments slender, 2–4 mm long, anthers ovoid, 1.5–2.5 mm long, glabrous, dehiscing extrorsely; *ovary ovoid*, *c.* 1.5 × 1 mm, 6-loculed, brownish sericeous, glabrous at base, style slender, 6–10 mm long, glabrous. **Fruits** globose, ellipsoid or depressed subglobose, *1–1.4 × 0.8–1.6 cm*, *1–2-seeded*; pericarp fleshy, glabrous. **Seeds** *ellipsoid*, *c. 0.9 × 0.6 cm*; scar covering about half of seed surface.

Vernacular name. Sarawak—*nyatoh babi* (Iban).

Distribution. Borneo and the Philippines. In Borneo, known from Sandakan, Sipitang and Tawau districts in Sabah (e.g., *SAN 15249*, *SAN 16731*, *SAN 24320*, and *SAN A 488*), Kuching, Limbang and Sibu districts in Sarawak (e.g., *S 0402*, *S 2678*, *S 19433*, *S 36132*, and *S 57118*), E, SE and SW Kalimantan (e.g., *bb. 33045* and *Kostermans 5685*), and Badas FR in Brunei.

Ecology. Frequent in freshwater and peat swamp forests. Also occurs in *kerangas* forest.

26. **Palaquium quercifolium** (de Vriese) Burck

(Latin, *quercifolium* = with leaves resembling those of *Quercus*, Fagaceae)

Ann. Jard. Bot. Buitenz. 5 (1886) 41; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 53; *l.c.* (1927) 399; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 562; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 151; Kessler & Sidiyasa *l.c.* 216; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 585. **Basionym:** *Isonandra quercifolia* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 311. **Type:** *Motley VII* (= *de Vriese 1367*), Borneo, Kalimantan, Bandjarmasin (holotype BO; isotype L). **Synonyms:** *Isonandra argentata* Teijsm. & Binn., Nat. Tijdschr. Ned.-Indie 25 (1863) 415; *Dichopsis argentata* (Teijsm. & Binn.) Benth. & Hook.*f.*, Gen. Pl. 2, 2 (1876) 658; *Palaquium argentatum* (Teijsm. & Binn.) Pierre *in* Burck *l.c.* (1886) 30; *I. macrophylla* de Vriese *l.c.* 311; *P. macrophyllum* (de Vriese) Pierre *ex* Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 9; *Croixia quercifolia* (de Vriese) Baehni *l.c.* 108.

Tree to 30 m tall. **Bark** red-brown, inner bark pale reddish. **Twigs** stout, 3–10 mm diameter, *brownish tomentose*, glabrescent. **Terminal buds** *4–8 mm long*, *brownish tomentose*. **Stipules** *linear-lanceolate*, *c. 10 × 2 mm*, brownish sericeous outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, *subcoriaceous*, glabrous above, *brownish* to *reddish tomentose below*; obovate-oblong or elliptic, (*8–*)*12–32* × (*3.5–*)*5–10 cm*, base cuneate, apex acuminate; midrib impressed above, rounded and prominent below; *lateral veins 14–16 pairs*, *ascending at an angle of 45–50° from midrib*, *diminishing and becoming inconspicuous toward leaf margin* or partly arching and joining into intramarginal vein along leaf margin, impressed above, prominent below; *intercostal venation* finely scalariform, *conspicuous on both sides*; *petiole 4–6 cm long*, *grooved on adaxial side*, *brownish tomentose* to *glabrous*. **Inflorescences** axillary, fascicles 4–5-flowered. **Flowers:** *pedicel* 8–10 mm long, *brownish tomentose*; sepals lanceolate, 4–5 × 2–3 mm, brownish tomentose outside, almost glabrous inside; corolla lobes ovate-lanceolate, 13–15 mm long, brownish tomentose; stamens 12, filaments slender, to 9 mm long, glabrous, *anthers ovoid* or *sagittate*, 2.5–3.5 mm long, glabrous; ovary discoid, *c.* 1.5 × 1 mm, 5–6-loculed, glabrous except for the brownish tomentose apex, style slender, 15–22 mm long, glabrous. **Fruits** globose, *c.* 2 cm diameter, 1-seeded; pericarp thin, glabrous. **Seeds** ellipsoid, *c.* 1.4 × 1.2 cm; scar broadly elliptic, *c.* 1.2 × 1 cm.

Distribution. Sumatra, Borneo, Sulawesi, and Ambon. In Sabah, recorded from Kinabatangan district, and in Sarawak from Anap, Bintulu and Lundu districts (e.g., *S 23707* and *S 36699*). Also occurs in C and S Kalimantan (e.g., *Kostermans 11169*) and in Brunei (e.g., *BRUN 34*).

Ecology. In lowland mixed dipterocarp forest and alluvial swamp forest.

27. **Palaquium ridleyi** King & Gamble

(H.N. Ridley, 1855–1956, former Director of the Singapore Botanic Gardens)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 196; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 92 & 257, *l.c.* (1927) 410; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 506; Ng *l.c.* 426; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 585. **Type:** *Ridley 3591a*, Singapore, Kranji (holotype K). **Synonyms:** *Palaquium ledermannii* Krause, Engl. Bot. Jahrb. 58 (1923) 552; *P. poilanei* Lecomte, Fl. Gen. Indo-Chine 3, 7 (1930) 900.

Tree to 30 m tall. **Bark** brownish grey, smooth to shallowly cracked; inner bark pinkish to light brown. **Twigs** slender, 2–5 mm diameter, subterete or angular especially towards apex, *covered* *with short brownish hairs*, glabrescent. **Terminal buds** 2–3 mm long, glabrous. **Stipules** *ovate-lanceolate*, *c. 2* × *1 mm*, apex acute, short-hairy outside, glabrous inside. **Leaves** *clustered at end of twigs*, *glabrous on both surfaces*, *subcoriaceous* to *thickly coriaceous*; usually *obovate*, 6–14.4 × 2.7–5.4 cm, base cuneate to attenuate, decurrent, apex obtuse or acute or with a narrow notch; midrib raised and crested above, angular or rounded below; *lateral veins 8–10 pairs*, *ascending at an angle of c. 45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, impressed and almost inconspicuous above, prominent below; *petiole 0.8–2 cm long*, flat on adaxial side, angular or rounded on abaxial side. **Inflorescences** mostly axillary amongst terminal leaves, fascicles 5–11-flowered. **Flowers:** *pedicel* slender, *to 15 mm long*, tomentose; sepals 6, ovate, *c.* 2 mm across, brownish tomentose outside, glabrous inside; corolla to 3 mm long, almost glabrous; stamens 10–12, filaments slender, 2–2.5 mm long, glabrous, *anthers oblong*, *c.* 1 mm long, sparsely hairy, dehiscing extrorsely; *ovary ellipsoid*, *c.* 1.5 × 1 mm, 5–6-loculed, *glabrous*, style stout, 1.5–2.5 mm long, glabrous. **Fruits** *obovoid*, *c. 1.5* × *1 cm*, 1–2-seeded, with short style remnant, glabrous. **Seeds** obovoid, *c.* 1 × 0.5 cm; scar narrow, *c.* 2 mm wide.

Vernacular name. Sarawak—*nyatoh terong* (Iban).

Distribution. Indo-China, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, and New Guinea. In Borneo, common in Sarawak (e.g., *S 0472*, *S 0680*, *S 7921*, *S 8040*, and *S 9013*), Sabah (e.g., *SAN 16775* and *SAN 16812*), Brunei (e.g., *BRUN 416* and *BRUN 1007*), and Kalimantan (e.g., *bb. 10706* and *bb. 16803*).

Ecology. In peatswamp and *kerangas* forests.

Uses. The timber is strong and resistant to attack by insects. Used for making shingles in Sumatra.

28. **Palaquium rigidum** Pierre *ex* Dubard

(Latin, *rigidum* = rigid; the stiff leaves)

Bull. Soc. Bot. Fr. 56, Mém 16 (1909) 18; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 564; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325. **Type:** *Beccari PB 2284*, Borneo, Sarawak, Matang (holotype FI; isotypes G, L).

Tree to 25 m tall. **Bark** reddish grey. **Twigs** stout, *c.* 6 mm diameter, subterete, *brownish tomentose*, glabrescent. **Terminal buds** *c.* 4 mm long, brownish tomentose. **Stipules** *ovate*, *c. 2.5* × *2 mm*, brownish tomentose on both sides, caducous. **Leaves** *clustered at ends of twigs*, *chartaceous*, *glabrous on both surfaces*; *obovate*, 13–15.5 × 4–6.5 cm, base cuneate, decurrent, apex obtusely acuminate; midrib impressed above, prominent and rounded below; *lateral veins 12–17 pairs*, *ascending at an angle of 65–75° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; intercostal venation scalariform, almost parallel to lateral veins, prominent on both sides; *petiole 2–2.8 cm long*, flat on adaxial side, brownish tomentose at base. **Inflorescences** axillary, fascicles 3–4-flowered. **Flowers:** *pedicel 7–15 mm long*, angular, brownish tomentose; outer sepals ovate-lanceolate, *c.* 6 × 4 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes oblong, *c.* 6 × 4 mm; stamens 12, in two whorls, filaments slender, 2.5–4 mm long, *anthers oblong*, 3–4 mm long, glabrous, dehiscing extrorsely; *ovary disc-like*, *c.* 1.5 × 1.5 mm, 6-loculed, *brownish tomentose*, style slender, 10–12 mm long, cylindrical. **Fruits** *globose*, *8–10 cm diameter*, 1-seeded; pericarp thin, finely tomentose. **Seeds** unknown.

Distribution. Endemic to Borneo. Confined to Sarawak and recorded from Matang (e.g., *Beccari PB 2284*), Semengoh FR and Baram area.

Ecology. In lowland mixed dipterocarp forest.

29. **Palaquium rioense** H.J.Lam

(of Riau province, Sumatra)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 89, *l.c.* (1927) 409; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 538; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Hort. Bog. IV. C. 23*, Sumatra, Riau, cultivated at the Bogor Botanic Gardens (holotype BO; isotype NY).

Tree, 20–40 m tall. **Bark** brown, inner bark pinkish. **Twigs** slender, 2–5 mm in diameter, terete, *brownish hairy*, glabrescent. **Terminal buds** *7–8.5 mm long*, tomentose. **Stipules** *lanceolate*, *c.* 6.5 × 3 mm, tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, glabrous above, *brownish tomentose below*; ovate to obovate, 14.5–17.5 × 2.5–3.5 cm, base cuneate, apex acuminate; midrib impressed above, round and prominent below; *lateral veins 16–17 pairs*, ascending at an angle of 50–65° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly impressed above, prominent below; intercostal venation finely scalariform, prominulous above, slightly more prominent below; *petiole 1.5–2 cm long*, *grooved on adaxial side*, brownish tomentose. **Inflorescences** axillary, fascicles few-flowered. **Flowers:** *pedicel* angular, to 10 mm long, *dark brownish tomentose*; outer sepals lanceolate, *c.* 3 × 1.5 mm, apex acute, brownish tomentose outside, glabrous inside, inner sepals with membranaceous glabrous margin; corolla lobes ovate-lanceolate, to 7.5 mm long, brownish sericeous outside along tube and base, brownish hirsute inside between stamens; stamens 12, filaments slender, 3–4 mm long, sparsely hairy at base, anthers ovoid-oblong, *c.* 2 mm long, apex apiculate, sparsely hairy at base, dehiscing extrorsely; ovary ovoid, *c.* 1.5 × 1 mm, brownish sericeous, style slender, 9–12 mm long, glabrous. **Fruits** obovoid, *c.* 2 × 1.5 cm, 1-seeded, glabrous; pericarp thin. **Seeds** slightly smaller than fruits; scar covering about one third of seed surface.

Distribution. Sumatra (Riau) and Borneo. In Borneo, found in Mt. Kinabalu area and SW part of Sabah (e.g., *Clemens 29022*, *Clemens 32080*, *Clemens 40605*, and *Clemens 50445*), C and N parts of Sarawak, Brunei and E Kalimantan (e.g., *Endert 3620* and *Endert 3643*).

Ecology. Mostly in hill and lower montane forests, at altitudes 300–1500 m.

30. **Palaquium rivulare** H.J.Lam

(Latin, *rivularis* = growing by watercourses)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 403; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 474; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Endert 3021*, Borneo, Kalimantan, W Kutai (holotype BO; isotype L).

Tree to 20 m tall. **Bark** pale brown, smooth. **Twigs** stout, 3–7 mm diameter, subterete, brownish tomentose to glabrous. **Terminal buds** *c.* 10 mm long, sparsely tomentose. **Stipules** *oblong*, *c.* 12 × 5 mm, subchartaceous, sparsely tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, *thinly chartaceous*, glabrous above, sparsely hairy below; oblong, 17–23 × 7.5–10 cm, base rounded, asymmetrical, apex obtusely acuminate; midrib impressed and crested above, prominent below; *lateral veins 18–22 pairs*, ascending at an angle of 55–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, almost inconspicuous above, prominent below; intercostal venation thin, scalariform, conspicuous on both sides; petiole stout, 0.9–2.6 cm long, flat on adaxial side, rounded on abaxial side, sparsely tomentose, glabrescent. **Inflorescences** axillary, fascicles 4–10-flowered. **Flowers:** pedicel angular, 5–10 mm long, brownish, almost glabrous; outer sepals triangular or ovate, 2.5–3 × 2 mm, apex obtuse, brownish tomentose outside, glabrous inside; inner sepals thin, glabrous, hairy along margin; corolla lobes ovate-oblong, 5–8 mm long, brownish, sparsely hairy; stamens 18–21, in two or three whorls, filaments short, subulate, 0.5–1.5 mm long, brownish hairy, anthers ovoid, 3–4 mm long, apex acuminate, brownish hairy, dehiscing extrorsely; ovary conical, *c.* 2 × 1 mm, 6-loculed, 6-lobed, brownish hairy, style cylindric, stout, 3–4 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo. Found throughout Sarawak (e.g., *S 37358* and *S 37464*) and NE Kalimantan (e.g., *Endert 3021* and *Kostermans 9701*).

Ecology. In mixed dipterocarp forest and limestone forest. Occasionally also in riparian forest.

31. **Palaquium rostratum** (Miq.) Burck

(Latin, *rostratus* = with a beak, narrowed into a slender tip; probably referring to the fruit)

Ann. Jard. Bot. Buitenz. 5 (1886) 39; H.J. Lam *l.c.* (1925) 40, *l.c.* (1927) 396; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 568; Ng *l.c.* 426; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 586. **Basionym:** *Isonandra ?rostrata* Miq., Fl. Ned.-Indie, Suppl. (1861) 581. **Type:** *Teijsmann HB 3276*, Sumatra, Bangka, Djebus (holotype BO; isotype L). **Synonyms:** *Croixia rostrata* (Miq.) Baehni *l.c.* 109; *Palaquium verstegei* Burck *l.c.* 35; *P. membranaceum* Burck *l.c.* 42; *P. parvifolium* Burck *l.c.* 36; *P. bancanum* Burck *l.c.* 43.

Tree to 45 m tall. **Bark** greyish brown, shallowly fissured, sometimes flaky; inner bark yellowish brown. **Twigs** 2–8 mm diameter, subterete to angular, *reddish-brown tomentose*, *not covered with prominent leaf scars*. **Stipules** *lanceolate*, *c. 1.5 × 0.5 mm*, apex acute, puberulous outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *glabrous on both surfaces*, *chartaceous*; obovate or spathulate, rarely elliptic, 7–14.5 × 3.5–6.5 cm, base cuneate, decurrent, apex rounded or obtusely acuminate; midrib flat or slightly impressed and faintly crested above, prominent and angular below; *lateral veins 15–18 pairs*, ascending at an angle of 75–90° from midrib, *arching and joining into intramarginal vein along leaf margin*; *intercostal venation descending from leaf margin and almost parallel to lateral veins*; *petiole 1.2–4 cm long*, *flat on adaxial side*, angular on abaxial side, glabrous. **Inflorescences** *axillary* or *crowded along leafless part of twigs*; fascicles 1–2-flowered. **Flowers:** pedicel to 6 mm long, brownish tomentose; sepals ovate, 4 × 2–3 mm, apex obtuse, brown tomentose outside, glabrous inside; corolla to 3 mm long, brownish tomentose to glabrous, densely brownish pubescent on corolla tube, lobes ovate, apex obtuse; stamens 12, filaments subulate, *c.* 0.7 mm long, brownish tomentose, soon becoming glabrous, anthers ovoid, *c.* 1 mm long, flattened, glabrous; *ovary discoid*, *c.* 1.5 × 1 mm, 6-loculed, brownish tomentose, style conoid, 1.5–3.5 mm long, glabrous. **Fruits** *ellipsoid*, *2–3.5 × 1.2–1.4 cm*, 1-seeded, apex rounded, with short remnant of style; pericarp fleshy, glabrous. **Seeds** ovoid 1–2.3 × 0.5–0.9 cm; scar covering about half of seed surface.

Distribution. Thailand, Sumatra (including Lingga, Riau, Bangka, and Biliton), Peninsular Malaysia, Java, Borneo (throughout; e.g., *BRUN 742*, *BRUN 5245*, *FD-F.M.S. 35433*, *Kostermans 6107*, *S 32873*, *S 38505*, *S 39709*, *SAN 16786*, *SAN 33805*, and *SAN A 3867*), Sulawesi, and Ambon.

Ecology. In *kerangas* and mixed dipterocarp forests on sandy soils, from sea level to about 1200 m altitude.

Uses. The timber is attractive and widely used for furniture-making and panelling. The fruits are edible.

32. **Palaquium rufolanigerum** P.Royen Fig. 20.

(Latin, *rufus* = reddish, *lanigerum* = wool-bearing; the reddish-brown woolly indumentum)

Blumea 10 (1960) 580; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Rambli 1754* (= *S 48*), Borneo, Sarawak, Kuching, Semengoh FR (holotype SAR; isotype KEP).

Tree, 20–30 m tall. **Bark** reddish brown, finely and shallowly fissured; inner bark rosy pink to reddish, soft. **Twigs** slender, *c.* 4 mm diameter, subterete, *covered with prominent leaf scars*, densely reddish-brown woolly-tomentose. **Terminal buds** *to 3 mm long*, densely reddish-brown woolly-tomentose. **Stipules** tomentose, *ovate*, *c.* 3 × 2 mm. **Leaves** *clustered at ends of twigs*, *chartaceous* to *subcoriaceous*, initially densely reddish-brown woolly tomentose, later *glabrous except for midrib*; spathulate, 6.7–9.5 × 2–3.3 cm, base narrowly cuneate, decurrent, apex rounded; midrib crested and sparsely hairy above, angular, prominent and densely reddish-brown woolly-tomentose below; *lateral veins 13–15 pairs*, *arching and joining into intramarginal vein along leaf margin*, almost inconspicuous above, fairly conspicuous below; *intercostal venation laxly reticulate*; petiole 0.8–1.3 cm long, densely reddish-brown woolly-tomentose. **Inflorescences** *borne in axils of leaf scars*, fascicles 2–3-flowered. **Flowers:** *pedicel* angular, *8–12 mm long*, densely reddish-brown woolly-tomentose; outer sepals triangular, 2–3 × 2–5 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous glabrous margin; corolla lobes 4–5 mm long, brownish sericeous; stamens 12, glabrous, filaments slender, *c.* 3 mm long, *anthers lanceolate*, *c.* 2 mm long, apex bifid, dehiscing extrorsely; *ovary* globose, *c.* 2.5 mm diameter, 6-loculed, *brownish hirsute*, style slender, to 10 mm long, base hirsute. **Fruits** *globose*, *1.2–1.5 cm diameter*, smooth, 1-seeded; *pericarp thin*. **Seeds** *laterally compressed*; *scar covering about one third of seed surface*.

Distribution. Endemic to Borneo. In Sabah, known by several collections from Beaufort district. In Sarawak, recorded from Kuching Division particularly in Semengoh FR, Bako NP, Kapit and Sri Aman Divisions (e.g., *S 048*, *S 24652*, *S 37630*, *S 44920*, and *S 47084*). Also occurs in Brunei and Kalimantan.

Ecology. In coastal to lower montane forests.

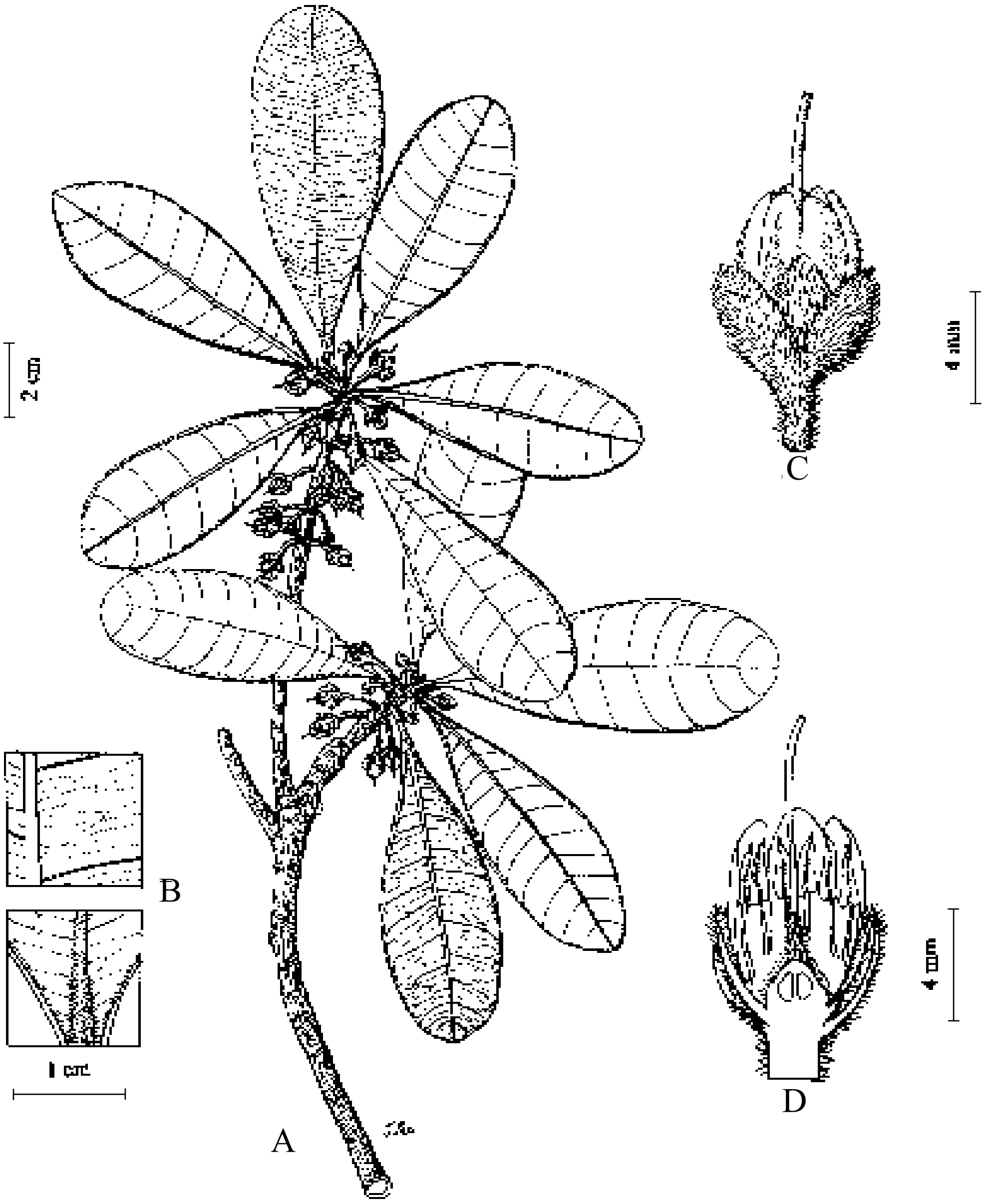

Fig. 20. *Palaquium rufolanigerum*. A, flowering leafy twig; B, detailed venation of leaf; C, flower; D, longitudinal section of flower. (All from *S 32502*.)

Notes. A very distinct species, easily recognised by its small, spathulate leaves and reddish-brown woolly indumentum.

33. **Palaquium sericeum** H.J.Lam

(Latin, *sericeus* = silky with long straight closely pressed glossy hairs; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 53, *l.c.* (1927) 399; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 463; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Kessler & Sidiyasa *l.c.* 216; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 586. **Type:** *Jaheri 716*, Borneo, Kalimantan, Blulu (holotype BO).

Tree to 22 m tall. **Bark** reddish brown, smooth, sometimes scaly; inner bark brown. **Twigs** slender, 1–3 mm diameter, *brownish sericeous*. **Terminal buds** *to 5 mm long*, woolly tomentose. **Stipules** *linear-lanceolate*, 2.5 × 1–1.5 mm, brownish sericeous outside, glabrous inside, persistent. **Leaves** *well-spaced along twigs*, *subcoriaceous*, glabrous above, *brownish sericeous below*; oblong to obovate, 15–38.5 × 7.5–10.5 cm, base rounded, sometimes oblique, apex acutely acuminate to emarginate; midrib impressed above, angular or rounded and prominent below; *lateral veins 23–25 pairs*, ascending at an angle of *c.* 55° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; intercostal venation scalariform, inconspicuous on both sides; *petiole* stout, *8–10 cm long*, *flat on adaxial side*, brownish sericeous. **Inflorescences** axillary, fascicles 12–20-flowered. **Flowers:** *pedicel* 10–25 mm long, angular, *brownish sericeous*; outer sepals ovate-lanceolate, 2–8 × 2 mm, brownish sericeous outside, glabrous inside, apex acute, inner sepals acute to rounded, glabrous, margin membranaceous; corolla to 10 mm long, glabrous, lobes ovate-lanceolate, apex subobtuse; stamens 12, filaments subulate, to 1 mm long, glabrous, anthers sagittate, 2–3 mm long, apex acuminate, glabrous, those of outer stamens dehiscing extrorsely, and those of inner ones introrsely; ovary conical, *c.* 2 × 1 mm, brownish sericeous, style slender, to 8 mm long, glabrous. **Fruits** globose or ellipsoid, 1.5–2.7 × 0.7–1.7 cm, sparsely hairy to almost glabrous. **Seeds** laterally compressed, ellipsoid, *c.* 1.5 × 1 cm; scar covering about one third of seed surface.

Distribution. Endemic to Borneo. In Sabah, confined to the eastern coastal areas (e.g., *SAN 16640*, *SAN 37023*, *SAN 88273*, *SAN 97137*, and *SAN 128234*). In Sarawak, recorded mainly from the central and northern parts (e.g., *S 22457*, *S 23343*, *S 24637*, *S 39815*, and *S 40202*). Also occurs in Brunei (e.g., *Dransfield JD 6555*, *Kirkup 360* and *Wong WKM 1568*) and C Kalimantan (e.g., *Mogea 4326*).

Ecology. In a wide range of forest types but more abundant in the lowland mixed dipterocarp forest and alluvial forest; occasionally also in limestone forest.

34. **Palaquium stellatum** King & Gamble

(Latin, *stellatum* = star-like; hairs of indumentum of the midrib and lateral veins)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 198; Ridley *l.c.* (1923) 277; H.J. Lam *l.c.* (1925) 71, *l.c.* (1927) 402; Wyatt-Smith *l.c.* 43; P. Royen *l.c.* (1960) 533; Ng *l.c.* 427; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152; Turner *l.c.* 466; Argent *et al.* (eds.) *l.c.* 586; Kochummen, TFPF (1997) 413. **Type:** *Scortechini 1855*, Peninsular Malaysia, Perak (holotype SING). **Synonyms:** *Bassia watsoni* Ridl. *l.c.* (1923) 267; *Madhuca watsoni* (Ridl.) H.J.Lam *l.c.* (1925) 179, *l.c.* (1927) 462.

Tree to 40 m tall. **Bark** brownish, peeling off; inner bark reddish brown. **Twigs** slender, 3–5 mm diameter, irregularly ridged, brownish hirsute, glabrescent. **Terminal buds** to 5 mm long, hirsute. **Stipules** lanceolate, *c.* 3 × 1.5 mm, brownish hirsute outside, glabrous inside, caducous. **Leaves** *clustered at ends of twigs*, subcoriaceous to chartaceous, *glabrous except for the stellate-hairy midrib and veins*; *elliptic* to *oblong*, *9–13.5 × 3–5 cm*, base cuneate, apex obtusely acuminate; midrib crested above, prominent and crested below; *lateral veins* 8–10 pairs, rusty stellate-tomentose on both sides, *ascending at an angle of c. 55° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, conspicuous on both sides; *intercostal venation* finely scalariform, *conspicuous on both sides*; *petiole* to 2.2 cm long, *shallowly grooved on adaxial side*, brownish hirsute. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** pedicels terete or angular, to 20 mm long, brownish hirsute; outer sepals ovate, *c.* 7 × 3 mm, inner sepals with membranaceous margin, dark brownish hirsute on both sides; corolla lobes elliptic-oblong, to 10 mm long; stamens 12, filaments lanceolate, angular, 3–4 mm long, glabrous, anthers oblong-lanceolate, *c.* 2 mm long, apex pointed, brownish tomentose, dehiscing extrorsely; *ovary* subglobose, *c.* 2 × 1.5 mm, *brownish hirsute*, style slender, 6–10 mm long, glabrous. **Fruits** *subglobose* to *globose*, *2–2.5 cm diameter*, *1–3-seeded*; pericarp fleshy, glabrous. **Seeds** spindle-shaped, *c.* 1.5 × 0.5 cm; scar narrow, 2–4 mm wide.

Distribution. Sumatra (Riau), Peninsular Malaysia and Borneo. In Sabah, known by one collection from Beaufort district, and in Sarawak known by a single record from Lambir NP. Also occurs in Kalimantan (e.g., *Kostermans 7951*).

Ecology. In lowland mixed dipterocarp forest especially on sandy loam soils.

Uses. The timber is very heavy, hard and durable.

35. **Palaquium stipulare** Pierre *ex* Dubard Fig. 21.

(Latin, *stipularis* = with prominent stipules)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 21; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 57, *l.c.* (1927) 399; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 488; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152. **Type:** *Beccari PB 1549*, Borneo, Sarawak, Matang (holotype P; isotype FI). **Synonym:** *Palaquium richardsii* Griffioen & H.J.Lam, Kew Bull. (1927) 17.

Tree to 30 m tall. **Bark** brownish grey, smooth to rough, powdery or cracked in older trees; inner bark reddish brown to pinkish. **Twigs** stout, 5–12 mm diameter, covered with prominent leaf scars, *brownish tomentose*. **Terminal buds** *to 15 mm long*, glabrescent. **Stipules** *scale-like*, *4–10 × 3–5 mm*, tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, *subcoriaceous*, *glabrous above*, *yellowish-brown tomentose below*; obovate, 10–20.5 × 6–14 cm, base cuneate, apex rounded; midrib impressed above, round and prominent below; *lateral veins 16–21 pairs*, *ascending at an angle of 50–60° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominent below, inconspicuous above; intercostal venation scalariform, inconspicuous on both sides; *petiole 1.5–3 cm long*, *grooved on adaxial side*, tomentose. **Inflorescences** axillary, fascicles 2–4-flowered. **Flowers:** *pedicel* subterete, 12–45 mm long, *brownish tomentose*; outer sepals ovate-elliptic, 7–10 × 5–7 mm, brownish tomentose outside, glabrous inside, inner sepals ovate, with membranaceous margin; corolla lobes elliptic-oblong, to 20 mm long; *stamens 19–27*, filaments lanceolate, 2–3.5 mm long, *anthers sagittate*,

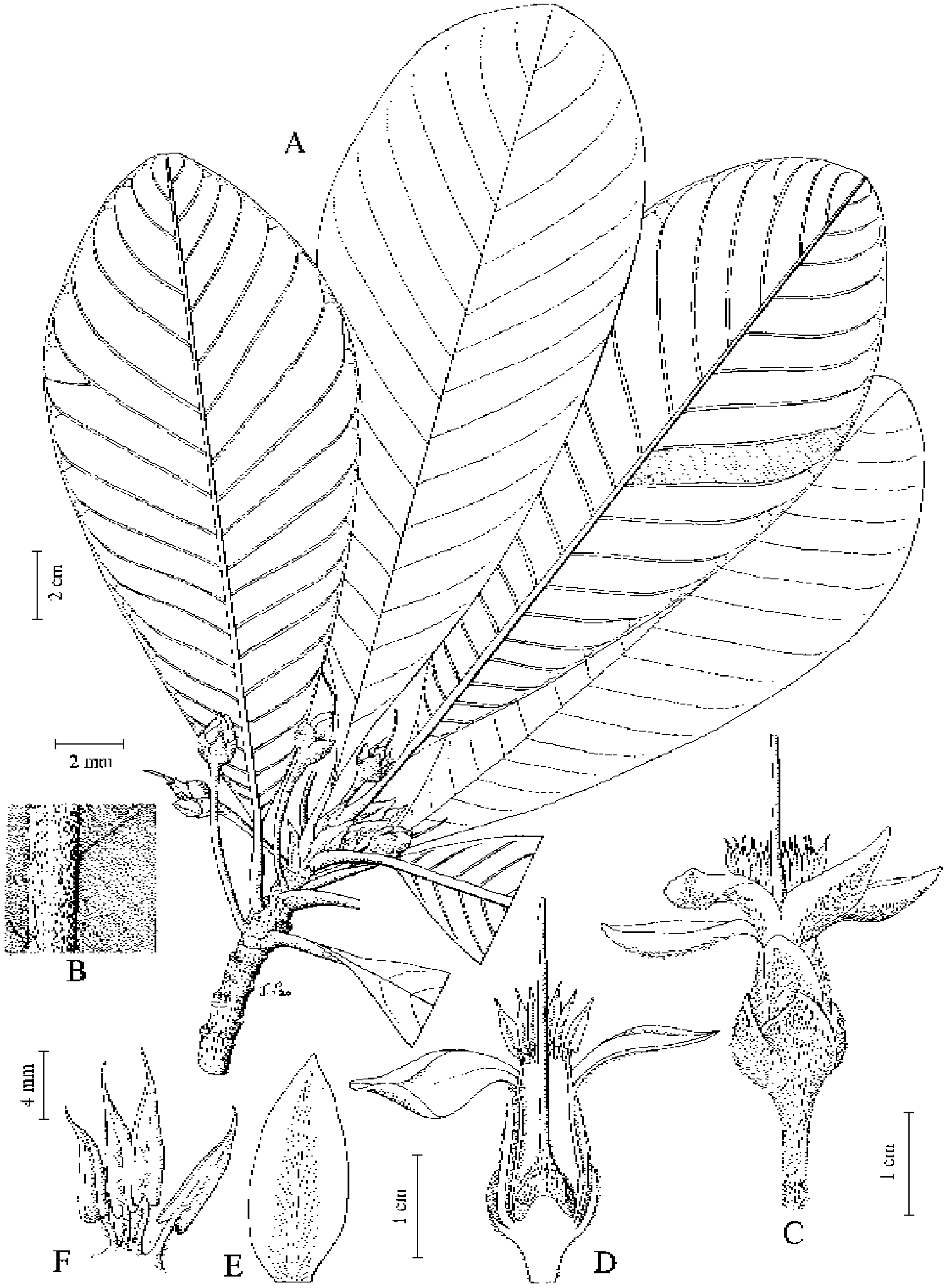

Fig. 21. *Palaquium stipulare*. A, flowering leafy twig; B, indumentum on lower leaf surface; C, open flower; D, longitudinal section of flower; E, petal; F, stamens. (All from *S 39251*.)

5–7 mm long, brownish tomentose; ovary ovoid, *c.* 2 × 1.5 mm, brownish tomentose, style slender, to 20 mm long, glabrous. **Fruits** globose, 2–2.7 cm diameter, 1-seeded, almost glabrous. **Seeds** unknown.

Distribution. Endemic to Borneo and recorded from Kuching, Miri, Kapit, and Bintulu districts in Sarawak (e.g., *Beccari PB 1549*).

Ecology. In lowland mixed dipterocarp forest on yellow clayey soils.

36. **Palaquium sumatranum** Burck

(of Sumatra)

Ann. Jard. Bot. Buitenz. 5 (1886) 34; Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 18; H.J. Lam *l.c.* (1925) 39, 254, *l.c.* (1927) 396; Masamune *l.c.* 326; P. Royen *l.c.* (1960) 595; Whitmore, Tantra & Sutisna *l.c.* 326. **Type:** *Teijsmann s.n.*, Sumatra (holotype BO). **Synonyms:** *Palaquium teysmannianum* Burck *l.c.* 38; *P. beauvisagei* Burck *l.c.* 38.

Tree to 45 m tall. **Bark** rusty brown, inner bark pale brown. **Twigs** stout, 4–7 mm diameter, *brownish puberulous* to glabrous. **Terminal buds** *to 12 mm long*, puberulous. **Stipules** *lanceolate*, *c. 5 × 1.5 mm*, puberulous outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; elliptic to obovate-oblong, 13–19 × 6–9.5 cm, base cuneate, apex rounded; midrib impressed above, angular and prominent below; *lateral veins 19–24 pairs*, *ascending at an angle of 70–85° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominulous above, prominent below; intercostal venation reticulate; *petiole 2.5–4 cm long*, *grooved on adaxial side*, slightly thickened at base, reddish puberulous, glabrescent. **Inflorescences** axillary, fascicles 1–3-flowered. **Flowers:** *pedicel* angular, 5–8 mm long, *brownish tomentose*; outer sepals ovate, 5–6 × 2–5 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes elliptic or ovate, to 8.5 mm long; *stamens 12*, filament linear, 2–3 mm long, glabrous, *anthers oblong-obovoid*, 2–3 mm long, glabrous, dehiscing extrorsely; ovary discoid, 1–1.5 mm long, brownish puberulous, 6-loculed, style subulate, 8–14 mm long, stigma 5-lobed. **Fruits** ovoid to obovoid, *c.* 2.5 × 1.5 cm, 1-seeded; pericarp very thin, glabrous. **Seeds** only slightly smaller than fruit; scar covering about one fourth of seed surface.

Distribution. Thailand, Sumatra (Biliton and Riau), Borneo, and Java. In Borneo, known from Ranau district in Sabah (e.g., *Clemens 40574*), southwestern part of Sarawak, and S and E Kalimantan (e.g., *bb. 14845*, *bb. 14878* and *bb. 19788*).

Ecology. In mixed dipterocarp forest.

37. **Palaquium supfianum** Schltr.

(K. Supf, German manufacturer)

Tropenpfl. 7 (1903) 469; H.J. Lam *l.c.* (1925) 60, *l.c.* (1927) 400; P. Royen *l.c.* (1960) 480. **Type:** *Schlechter 13921*, New Guinea, Bismarck Mts. (holotype B†; isotype P). **Synonym:** *P. inutile* Schltr. *ex* Krause, Engl. Bot. Jahrb. 58 (1923) 469.

Tree to 35 m tall. **Twigs** stout, subterete, brownish tomentose, glabrescent. **Terminal buds** *10–12 mm long*. **Stipules** lanceolate, *to 10 mm long*, pubescent on both sides, caducous. **Leaves** *clustered at ends of twigs*, *coriaceous*, glabrous above, *densely brownish-tomentose below*; obovate, *10–25 × 5–8 cm*, base cuneate, decurrent, apex acute or obtusely acuminate or sometimes rounded; midrib impressed above, prominent below; *lateral veins 12–15 pairs*, ascending at an angle of 45–60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, prominulous above, prominent below; *intercostal venation* scalariform, *prominent on both sides*; *petiole* thickened, *c. 1.5 cm long*, grooved on adaxial side, wrinkled on abaxial side. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** *pedicel* angular, *c. 25 mm long*, brownish tomentose; outer sepals ovate or triangular, *c.* 5 mm across, brownish tomentose outside, glabrous inside, inner sepals glabrous, with membranaceous margin; corolla lobes to 10 mm long, apex acuminate, curled outwards at anthesis; stamens 12, filaments slender, 3–4 mm long, glabrous, *anthers ovoid*, *c.* 3 mm long, apex acuminate, sparsely hairy, dehiscing extrorsely; ovary globose, *c.* 2 mm diameter, 6-loculed, brownish tomentose, style stout, angular, 5–12 mm long, pubescent. **Fruits** globose, brownish sericeous, glabrescent. **Seeds** unknown.

Distribution. Borneo and New Guinea. In Borneo, uncommon, known by one collection (*S 39972*) from Sg. Jelini, Belaga district, Sarawak.

Ecology. In lowland mixed dipterocarp forest at about 800 m altitude.

Notes. The disjunct distribution is somewhat unusual, and therefore, the correct identity of the specimen cited above and the occurrence of the species in Sarawak is doubtful (Editors).

38. **Palaquium tenuipetiolatum** Merr.

(Latin, *tenuis* = thin, *petiolum* = leaf stalk; the slender petiole)

Bur. Govt. Lab. Publ. 17 (1904) 45, Phil. J. Sc. 1, Suppl. (1906) 144, Enum. Phil. Fl. Pl. 3, 3 (1923) 283; H.J. Lam *l.c.* (1925) 95, *l.c.* (1927) 410; P. Royen *l.c.* (1960) 529. **Type:** *Barnes 154*, the Philippines, Luzon, Lamao R. (holotype PNH; isotypes NY, SING). **Synonym:** *Croixia tenuipetiolata* (Merr.) Baehni *l.c.* 109.

Tree to 30 m tall. **Twigs** slender, 3–4 mm diameter, brownish tomentose at apex, glabrescent. **Terminal buds** *to 10 mm long*, tomentose. **Stipules** *lanceolate*, *c.* 2 × 1 mm, tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, *chartaceous*, *glabrous on both surfaces*; elliptic, 5–7 × 2–2.5 cm, base cuneate, decurrent, apex acuminate or caudate; midrib slightly impressed and crested above, round and prominent below; *lateral veins 12–14 pairs*, *diminishing and becoming inconspicuous toward leaf margin*, ascending at angle of 60–70° from midrib, prominulous on both sides; intercostal venation scalariform, inconspicuous on both sides; petiole 1.5–2 cm long, grooved on adaxial side, wrinkled on abaxial side, brownish tomentose. **Inflorescences** axillary, fascicles 1–3-flowered. **Flowers:** pedicel 3–10 mm long, angular, brownish pubescent; sepals ovate-triangular, *c.* 3 mm across, outer ones smaller and thicker than inner ones, apex obtuse, inner ones with membranaceous margin, brownish tomentose outside, glabrous inside; corolla to 6 mm long, glabrous, lobes elliptic, obtuse at apex, reflexed when fully open; stamens 12, filaments slender, *c.* 3.5 mm long, glabrous, anthers ovoid to ellipsoid, *c.* 2 mm long, apex bifid, dehiscing extrorsely, brownish tomentose; ovary discoid, *c.* 3 × 2 mm, 6-loculed, 12-lobed, style subulate, 7–10 mm long, glabrous except for the brownish hirsute base. **Fruits** ovoid or fusiform, oblique, *c.* 2.5 × 1.5 cm, 1-seeded, obtusely acuminate at apex;

pericarp thin, glabrous. **Seeds** almost as big as fruit; scar covering about half of seed surface.

Distribution. Borneo and the Philippines. In Borneo, rare, known by a single collection (*S 39644*) from G. Mulu NP in Sarawak.

Ecology. In mixed dipterocarp forest.

39. **Palaquium vexillatum** P.Royen

(Latin, *vexillatus* = flag-like; the stipules)

Blumea 10 (1960) 494; Whitmore, Tantra & Sutisna *l.c.* 326. **Type:** *Kostermans 7325*, Borneo, Kalimantan, Balikpapan (holotype L; isotype BO).

Tree to 38 m tall. **Bark** light brown, fissured; inner bark whitish to tinged reddish. **Twigs** slender, 2–4 mm diameter, *angular*, *brownish tomentose*, glabrescent. **Terminal buds** *6–8 mm long*, brownish sericeous. **Stipules** slender, *twisted and protruding from terminal bud like small flags*, *to 8 mm long*, brownish hairy outside, glabrous inside. **Leaves** *well-spaced along twigs*, *chartaceous*, glabrous above, *densely brownish-tomentose below*; ovate to elliptic, *5–9 × 1.8–4.5 cm*, base cuneate, apex acuminate; midrib impressed and crested above, rounded and prominent below; *lateral veins 8–12 pairs*, *ascending at an angle of 60–65° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominulous on both sides; intercostal venation finely scalariform, fairly conspicuous on both sides; *petiole* 0.8–2.4 cm long, *grooved on adaxial side*, rounded on abaxial side, *brownish tomentose*. **Inflorescences** *axillary*, fascicles to 5-flowered. **Flowers:** *pedicel* 2–5 mm long, subterete, *brownish tomentose*; outer sepals triangular, ovate or elliptic, *c.* 2.5 × 2 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous and hairy margin; corolla lobes elliptic, to 2 mm long, glabrous outside, brownish tomentose inside; stamens 12, in two whorls, filaments subulate, *c.* 0.2 mm long, glabrous, *anthers sagittate*, *c.* 0.8 mm long, apex bifid, brownish hairy, *dehiscing extrorsely*; ovary obovoid, *c.* 1.5 mm across, 6-loculed, glabrous at base, puberulous at apex, style clavate, *c.* 1 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and recorded from Ranau district in Sabah and from Balikpapan in Kalimantan (e.g., *Kostermans 7325*).

Ecology. Locally common in secondary forest on brownish sandy soils.

40. **Palaquium walsurifolium** Pierre *ex* Dubard

(Latin, with leaves like those of *Walsura*, Meliaceae)

Bull. Soc. Bot. Fr. 56, Mém 16 (1909) 22; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 77, 256, *l.c.* (1927) 407; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 492; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152. **Type:** *Beccari PB 557*, Borneo, Sarawak, Kuching (holotype P; isotypes FI, G, L, NY, S).

Tree to 30 m tall, with stilt roots. **Bark** rusty brown, pock-marked, inner bark rusty brown. **Twigs** slender, 2–3 mm diameter, *brownish tomentose*, glabrescent. **Terminal buds** *to 3 mm* *long*, brownish tomentose. **Stipules** *triangular*, *c. 2.5 mm across*, tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *subcoriaceous*, *glabrous on both surfaces*; *obovate*, 6–9 × 3–4.5 cm, apex acuminate; midrib slightly impressed above, rounded and prominent below, sometimes distinctly dark brown; *lateral veins 7–12 pairs*, ascending at an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, *impressed above*, *prominent below*; *intercostal venation* scalariform, insconspicuous above, *prominulous below*; *petiole* 1.2–2.2 cm long, grooved or flat on adaxial side, *glabrous*. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** *pedicel 15–17 mm long*, terete, brownish tomentose; sepals ovate, 2.5–4 × 2 mm, brownish puberulous outside, glabrous inside and along margin; corolla lobes ovate-elliptic, to 5 mm long; stamens 12, filaments slender, *c.* 2.5 mm long, glabrous, *anthers ellipsoid*, *c.* 1.5 mm long, *glabrous*, dehiscing laterally or extrorsely; ovary globose, *c.* 1 × 1 mm, 6-loculed, brownish tomentose, style slender, 5–8 mm long, glabrous. **Fruits** *subglobose*, 1.2–1.8 × 1–1.5 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** ellipsoid, slightly smaller than fruit; scar covering about one third of seed surface.

Vernacular name. Sarawak—*nyatoh jangkar* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only by a few collections from Sarawak (Kuching and Sibu districts; e.g., *Beccari 557*, *Carroll 7172*, *Haviland 1875*, and *S 4773*) and SW Kalimantan (e.g., *bb. 12888*).

Ecology. In peat swamp, lowland mixed dipterocarp and alluvial forests.

41. **Palaquium xanthochymum** (de Vriese) Pierre

(Greek, *xantho-* = yellow, *chymum* = latex; with yellow latex)

In Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 30; King & Gamble *l.c.* 194; Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 11; Ridley *l.c.* (1923) 275; H.J. Lam *l.c.* (1925) 77, 256, *l.c.* (1927) 407; Masamune *l.c.* 598; P. Royen *l.c.* (1960) 576; Ng *l.c.* 428; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Turner *l.c.* 467; Argent *et al.* (eds.) *l.c.* 587. **Basionym:** *Isonandra xanthochyma* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 311. **Type:** *Motley VI* (= *de Vriese 1366*), Borneo, Kalimantan, Bandjarmasin (holotype BO; isotypes BM, L). **Synonyms:** ?*Dichopsis rubens* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 543; *Palaquium rubens* (C.B.Clarke) Engl., Bot Jahrb. 12 (1890) 511; *P. lanceolatum auct. non* Blanco: Burck *l.c.* (1886) 43; *Croixia xanthochyma* (de Vriese) Baehni *l.c.* 109.

Tree to 40 m tall. **Bark** smooth to shallowly fissured. **Twigs** stout, 3–10 mm diameter, subterete, becoming more or less angular towards apex, *covered with prominent leaf scars*, brownish pubescent near terminal buds. **Terminal buds** *to 6 mm long*, acute, brownish pubescent. **Stipules** *ovate*, 2.5 × 1.5 mm, acute at apex, brownish pubescent outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *membranaceous* to *subcoriaceous*, *glabrous on both surfaces*, rarely puberulous below; obovate, elliptic or spathulate, 8–11.5 × 3.5–5 cm, base decurrent, apex rounded to acuminate; midrib impressed and crested above; *lateral veins 14–20 pairs*, ascending at an angle of *c.* 70° from midrib, *arching and joining into intramarginal vein along leaf margin*, prominulous above, prominent below; *intercostal venation scanty*, *mostly scalariform* or sometimes *subreticulate*; petiole 1–1.5 cm long, grooved on adaxial side, rounded or angular on abaxial side, glabrous or brownish puberulous. **Inflorescences** *axillary*, fascicles 4–5-flowered. **Flowers:** *pedicel 3–9 mm long*, angular, sparsely brownish sericeous; sepals ovate-triangular, brownish tomentose outside, glabrous inside; corolla to 10 mm long, glabrous; stamens 12, glabrous, filaments subulate, 1–2 mm long, *anthers oblong*, 2–3 mm long, dehiscing extrorsely; *ovary* ovoid, *c.* 1 mm across, 6-loculed, *glabrous*, style slender, 9–14 mm long, glabrous. **Fruits** *oblong* or *fusiform*, *c. 3.5 × 1.5 cm*; *pericarp fleshy*, tomentose. **Seeds** *fusiform*, *c.* 2.5 × 0.5 cm; *scar covering about half of seed surface*.

Distribution. Sumatra (Riau, Lingga and Bangka), Peninsular Malaysia, Java, and Borneo. In Borneo, uncommon, known by three collections from Kuching district in Sarawak, and by one specimen from Banjarmasin area in SE Kalimantan (e.g., *Motley VI = de Vriese 1366*).

Ecology. In mixed swamp and mixed dipterocarp forests, at altitudes to 400 m.

Uses. The timber is moderately heavy, hard and not easily split. It is particularly suitable for making boats.

9. **PAYENA** A.DC.

(A. Payen, 1795–1871, French chemist)

J.T. Pereira

Prodr. 8 (1844) 196; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 47; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 167; Merrill, EB (1921) 476; Ridley, FMP 2 (1923) 261; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 130, *ibid.* 3, 8 (1927) 430; Masamune, EPB (1942) 598; Browne, FTSB (1955) 322; A. Bruggen, Blumea 9 (1958) 95; Backer & Bakhuizen *f.*, FJ 2 (1965) 192; Smythies, CST (1965) 126; Burgess, TS (1966) 447; Ng, TFM 1 (1972) 428; Anderson, CLTS (1980) 319; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 326; Pennington, Gen. Sapot. (1991) 159; PROSEA 5, 1 (1993) 333; Kessler & Sidiyasa, TBSA-EK (1994) 217; Coode *et al.* (eds.), CLBD (1996) 308; Pereira, Kew Bull. 52, 4 (1997) 903; Argent *et al.* (eds.), MNDT-CK 2 (1997) 587. **Synonyms:** *Keratophorus* Hassk., Flora Bot. Zeit. 38 (1855) 578; *Ceratophorus* de Vriese, Pl. Ind. Bat. Or. (1856) 60; *Hapaloceras* Hassk., Flora Bot. Zeit. 42 (1859) 639.

Trees with buttresses. **Stipules** present, caducous. **Leaves** *alternate and distichous on horizontal shoots*, sometimes somewhat spiral on upright shoots; blades with entire and plane margin; lateral veins arching and joining near leaf margin to form intramarginal vein-loops; *intercostal venation descending from leaf margin and branching out towards midrib and parallel to lateral veins*, rarely with intervening veins arising from midrib. **Inflorescences** 1–many-flowered fascicles, axillary or borne on leafless nodes, sometimes crowded at distal end of twigs (e.g., *P. leerii*). **Flowers** bisexual; *sepals 4*, *more or less free*, *arranged in two whorls of two*, outer sepals valvate, densely to sparsely hairy, thick and fleshy, inner sepals imbricate, thin, margin ciliate; corolla easily detached, lobes 7–9, not divided into segments, imbricate, equal or exceeding corolla tube; stamens (13–)14–18(–30), arranged in one or two whorls, inserted at top of corolla tube, filaments free or partially or completely fused in pairs or bundles, anthers extrose or laterally dehiscent, apex acuminate, or bifid to lacerate; staminodes absent; disk (nectary) absent or a poorly developed annulus around base of ovary; ovary (4–)8(–9)-loculed, globose or conoidal, style subulate, exserted; ovules one per locule. **Fruits** indehiscent with persistent calyx and style, 1–2-seeded. **Seeds** slightly to strongly compressed; scar adaxial, long and narrow; cotyledons foliaceous; endosperm copious.

Distribution. About 19 species, distributed in Myanmar, Thailand, Andamans, Sumatra (including Simalur, Riau and Bangka), Peninsular Malaysia, Java, Borneo and southern part of the Philippines. Twelve species are recorded for Borneo, including 8 endemic species.

Ecology. Common main canopy or emergent trees in primary mixed dipterocarp forest, occasionally in secondary forest and forest edges along rivers, and in lower montane and montane forest, at altitudes to 3000 m (e.g., Mt. Kinabalu), on various types of soils. Some species are restricted to a certain habitat, e.g., *P. leerii* is recorded along coastal areas in mixed swamp forest and *kerangas* forest in Borneo.

Uses. The wood of *Payena* is normally traded as *nyatoh*, which is a light-weight to medium-heavy hardwood, e.g., *P. acuminata.* It is also traded as *bitis* (*nyatoh batu*), a heavy hardwood, e.g., *P. leerii*. The timber is usually marketed with that of other Sapotaceae genera. *Nyatoh* is frequently used for the manufacture of fine furniture, decorative doors and panelling whereas *nyatoh batu* is more durable and used in constructional work, paving blocks, heavy-duty flooring and window frames. Some species, e.g., *P. leerii*, produce gutta-percha, a purified coagulated latex. It was formerly used to insulate submarine cables, as a tooth filler in dentistry, in manufacturing surgical instruments, and also as an ingredient of chewing gum. Fruits of some species are reported to be edible. A decoction of the roots of *P. lucida* was used in traditional medicine where it was given to women after childbirth (Burkill, EPMP 2 (1935) 1678).

Taxonomy. Since A.C. de Candolle first described the genus in 1844, its division into various subgroups has undergone many changes. De Candolle (*l.c.* 196) recognised *Payena* as having twice as many corolla lobes as sepals and the stamens all fertile, opposite the corolla lobes. A. Bruggen (*l.c.* 98) treated the genus for the Malesian region and subdivided it into two sections based on flower colour and the type of indumentum on the various parts of the plant. These are section *Purpureopayena*, represented by *P. dasyphylla*, and section *Payena*, where the rest of the species are grouped. According to Pennington (*l.c.* 160), *Payena* is closely allied to *Madhuca* (both in the tribe *Isonandreae*) in having similar flower structure. It differs from *Madhuca* by the alternate and distichous leaves (nearly always spiral in *Madhuca*), intercostal venation parallel to lateral veins and descending from the leaf margin (mostly oblique or reticulate venation in *Madhuca*) and embryo with foliaceous cotyledons and copious endosperm (cotyledons usually thick and flat, endosperm absent or very thin in *Madhuca*).

Key to *Payena* species

1. Lower surface of mature leaves densely golden-yellow appressed hairy………………… ……………………………………………………………………**1. P. acuminata**
   Lower surface of mature leaves glabrous and/or sparsely brown appressed or patent hairy……………………………………………………………………………2

2. Leaves of flowering or fruiting branch larger, (20–)25–35 × 8–12(–14) cm.......3
   Leaves of flowering or fruiting branch smaller, 4.5–16(–20) × 2–7 cm...............4

3. Stipules narrowly triangular, 6–10 × 1.5–2.5 mm, caducous. Lateral veins arching and joining to form vein-loops near leaf margin. Fruits glabrous; stalk 5–6 cm long..……... ……………………………………………………………………………**3. P. gigas**

Stipules large, ovate to suborbicular, 15–25 × 10–15 mm, persistent. Lateral veins joining to form a distinct smooth vein parallel to leaf margin. Fruits brown velvety-hairy; stalk 8–10 cm long…………………………………**4. P. grandistipula**

4. Leaf acumen 2–3 cm long. Pedicel 2–3 mm long. Corolla lobes hairy along the longitudinal median parts. Filaments densely hairy…………………………**8. P. lamii**
Leaf acumen typically shorter than 2 cm. Pedicel longer than 5 mm. Corolla lobes glabrous. Filaments glabrous……………………………………………………………5

5. Young twigs, petiole, or midrib on lower leaf surface tomentose…………………6
Young twigs, petiole, or midrib on lower leaf surface glabrous, subglabrous to densely sericeous……………………………………………………………………8

6. Lateral veins faint on lower leaf surface, joining to form a smooth vein parallel to leaf margin. Ovary 3–4 mm across, hairy; style hairy at its basal half…**5. P. kapitensis**
Lateral veins prominent on lower leaf surface, arching and joining to form vein-loops near leaf margin. Ovary 1–2 mm across, glabrous; style glabrous………………………7

7. Leaves chartaceous to thinly coriaceous, intercostal venation prominent beneath. Outer sepals densely rusty-tomentose. Stamens in two whorls. Young fruits ovoid to ellipsoid, abruptly terminated by a slender style………………………………**2. P. ferruginea**
Leaves thickly coriaceous, intercostal venation obscure on both sides. Outer sepals sparsely sericeous. Stamens in one whorl. Young fruits very narrowly ovoid, gradually tapering to a sharp point…………………………………**6. P. khoonmengiana**

8. Leaf upper surface white-waxy. Inflorescences axillary, mostly at distal ends of twigs. Fruits conical…………………………………………………………**9. P. leerii**
Leaf upper surface not white-waxy. Inflorescences axillary or on leafless nodes. Fruits ovoid, narrowly ovoid to ovoid-ellipsoid……………………………………………9

9. Lateral veins joining to form a smooth vein parallel to leaf margin. Stipules 0.5–1 mm wide. Pedicel 5–20 mm long. Fruit stalk 0.5–2 cm long; persistent inner sepals 3.5–4 mm long……………………………………………………**11. P. microphylla**
Lateral veins arching and joining to form vein-loops near leaf margin. Stipules 1–2 mm wide. Pedicel (20–)25–35(–45) mm long. Fruit stalk 2.5–6 cm long; persistent inner sepals 5–10 mm long…………………………………………………10

10. Stipules triangular, 1–1.5 mm wide. Outer sepals of flowers 7–12 mm long, inner sepals 8–13 mm long. Corolla lobes 8–12 mm long. Stamens in two whorls, anthers hairy…………………………………………………**10. P. longipedicellata**
Stipules ovate, 1.5–2 mm wide. Outer sepals of flowers 4–7 mm long, inner sepals 4–7.5 mm long. Corolla lobes 5–9 mm long. Stamens in one whorl, anthers glabrous……………………………………………………………………11

11. Young twigs subglabrous. Petiole 2–3 mm thick. Pedicel 1–1.5 mm thick. Corolla tube 0.5–1 mm long. Style 6–10 mm long. Fruits 2.5–3 × 1–1.5 cm; stalk 5–6 cm long. Seed 1–1.5 × 0.7 cm………………………………………**7. P. kinabaluensis**
Young twigs sericeous. Petiole (1–)1.5–2 mm thick. Pedicel 0.5–1 mm thick. Corolla

tube 3–6 mm long. Style 12–20 mm long. Fruits 4–5 × 1.5–2.5 cm; stalk 2.5–4 cm long. Seed 2–3 × 1–1.5 cm...**12. P. obscura**

1. **Payena acuminata** (Blume) Pierre

(Latin, *acuminatus* = tapering into a narrow point; the leaf apex)

Bull. Mens. Soc. Linn., Paris 1 (1885) 528; Merrill, PEB (1929) 238; Masamune *l.c.* 598; A. Bruggen *l.c.* 100; Backer & Bakhuizen *f. l.c.* 192; Burgess *l.c.* 448; Ng *l.c.* 429; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 160; PROSEA *l.c.* 338; Turner, Gard. Bull. Sing. 47 (1995) 467; Pereira *l.c.* 917; Argent *et al.* (eds.) *l.c.* 588. **Basionym:** *Mimusops acuminata* Blume, Bijdr. Fl. Ned. Ind. (1825) 672. **Lectotype** (A. Bruggen, 1958)**:** *Blume 239*, Java (hololectotype L). **Synonyms:** *Bassia sericea* Blume *l.c.* 674; *Isonandra pulchra* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 21; *Payena sericea* (Blume) H.J.Lam var. *typica l.c.* (1925) 140, *l.c.* (1927) 441; *P. sericea* (Blume) H.J.Lam var. *pulchra* (Burck) H.J.Lam *l.c.* (1925) 142, *l.c.* (1927) 441; *P. acuminata* (Blume) Pierre var. *acuminata*, A. Bruggen *l.c.* 101; *P. acuminata* (Blume) Pierre var. *pulchra* (Burck) A. Bruggen *l.c.* 103; *Madhuca acuminata* (Blume) Baehni, Boissiera 11 (1965) 36.

Tree to 30 m tall, 75 cm diameter. **Bark** brown, smooth to flaky; inner bark brownish yellow to brownish red. **Sapwood** pale yellow to white. **Twigs** (young) slender, terete, golden-yellow appressed hairy. **Stipules** narrowly triangular, 4–5 × 1.5 mm, golden hairy. **Leaves** subcoriaceous to chartaceous, glabrous above, *densely golden-yellow appressed hairy beneath*; broadly to narrowly elliptic, 10–22 × 3.5–8 cm, base rounded to cuneate, apex acuminate, acumen 0.5–1.5 cm long; midrib flat to slightly raised and glabrous above, slightly raised and sericeous beneath; lateral veins 14–25 pairs, at an angle of 70–80° with midrib, obscure above, faint and golden appressed-hairy beneath, joining and arching to form vein-loops near leaf margin; intercostal venation faint on both sides; petiole 1–3 cm long, 1.5–2.0 mm thick, sparsely golden appressed-hairy, soon-glabrescent. **Inflorescences** axillary or borne on leafless nodes, 5–20-flowered. **Flowers:** pedicel 10–20 mm long, *c.* 1 mm thick, golden hairy; outer sepals triangular, 5–7 × 4–5(–6) mm, densely golden-hairy, inner sepals narrowly triangular, 5–6.5 × 3.5–5 mm, densely golden-hairy; corolla lobes ovate, (3–)4–6 × 1.5–2 mm wide, glabrous, corolla tube 2–2.5 mm long, glabrous; stamens 16, in one whorl, filaments 0.5–1.5 mm long, glabrous, anthers 2–3 mm long, glabrous; ovary conical, 1.5–2 mm across, golden-yellowish hairy, style 6–9 mm long, glabrous. **Fruits** drying ridged, ellipsoid, 3–4 × 1.5–2 cm, abruptly terminated by a slender style, golden appressed-hairy; persistent outer sepals 5–9 × 4–5 mm, persistent inner sepals 5–7 × 4–5 mm; persistent style to 0.8 cm long; stalk 1.5–2.5 cm long, 1.5–2.5 mm thick, golden appressed-hairy. **Seeds** ellipsoid, 2.5 × 1.5 cm; scar 0.2–0.4 cm wide.

Vernacular names. Sabah—*natu*, *nyatoh merah* (Malay). Sarawak—*bee-taul* (Murut), *nyatoh rian* (Malay). Kalimantan—*malau pedara* (Bassap).

Distribution. A widespread species ranging from Thailand, Sumatra (Riau and Simalur), Peninsular Malaysia, Java to Borneo (Sabah, Sarawak and Kalimantan). In Sabah, occurs mainly in the east coast (e.g., *Elmer 21236*, *SAN 21302*, *SAN 57091*, and *SAN 109594*). In Sarawak, recorded from the 1st, 3rd and 5th Divisions (e.g., *S 235*, *S 23658*, *S 31578*, and *S 32676*).

Ecology. In primary and secondary mixed dipterocarp forests, common on slopes or ridges, at altitudes to 400 m; sometimes occurring on limestone.

Uses. The timber is of commercial value. It also produces gutta percha and the fruits are edible.

2. **Payena ferruginea** J.T.Pereira Fig. 22.

(Latin, *ferrugineus* = rusty brown; the indumentum)

Kew Bull. 52 (1997) 905. **Type:** *Ahmad SAN 47698*, Borneo, Sabah, Lahad Datu, Silam Road (holotype KEP; isotypes K, L, SAN, SAR). **Synonyms:** *Payena longipedicellata auct. non* King & Gamble: A. Bruggen, Blumea 9 (1958) 115, *p.p.*; *P. lucida auct. non* (Wall. *ex* G.Don) A.DC.: A. Bruggen *l.c.* 111, *p.p.* (specimens from Borneo); *P. lowiana auct. non* Pierre: A. Bruggen *l.c.* 126, *p.p.* (specimens from Borneo).

Tree to 35 m tall, 75 cm diameter, buttresses to 3 m high. **Bark** dark brown to grey, fissured to smooth; inner bark red-brown. **Sapwood** pale yellow to pink. **Twigs** (young) *densely rusty-tomentose*. **Stipules** narrowly triangular, 1.5–3 × 1–2 mm, densely rusty-tomentose. **Leaves** *chartaceous* to *thinly coriaceous*, glabrous above, *sparsely brown-tomentose beneath*; ovate, elliptic to lanceolate, *8–15 × 3–6.5 cm*, base cuneate to slightly rounded, sometimes oblique, apex acuminate, *acumen 0.3–1.7 cm long*; *midrib* flat, glabrous to tomentose above, prominent and *tomentose beneath*; *lateral veins* 8–16 pairs, at an angle of 60–70° with midrib, obscure and glabrous above, *prominent* and rusty tomentose to glabrous *beneath*, *arching and joining to form vein-loops near leaf margin*; *intercostal venation* faint above, *prominent beneath*; *petiole* (1–)2–3.5 cm long, 1–2 mm thick, *rusty tomentose*. **Inflorescences** axillary or borne on leafless nodes, 2–9-flowered. **Flowers:** *pedicel* (*10–*)*20–30 mm long*, 0.5–1 mm thick, rusty tomentose; *outer sepals* ovate, rounded or acute at apex, 4–6 × 4–6 mm, *densely rusty-tomentose*, inner sepals broadly ovate, 4–6 × 5–8 mm, rusty tomentose; *corolla lobes* broadly ovate with wavy margin, 3–5 × 3–5 mm, *glabrous*, corolla tube 3.5–5 mm long, glabrous; *stamens in two whorls*, *filaments* with two lengths, 0.5–1 mm and 2–2.5 mm long, *glabrous*, anthers 2–3 mm long, glabrous; *ovary 1.5–2 mm across*, *glabrous*, *style* 9.5–15 mm long, *glabrous*. **Fruits** (young) drying black, *ovoid* to *ellipsoid*, 2–3.5 × *1.5–2 cm*, *abruptly terminated by a slender style*, glabrous; persistent outer and inner sepals recurved, 4–6 × 4–7 mm; persistent style to 1 cm long; stalk 1.5–3.5 cm long, 1.5–2 mm thick, subglabrous. **Seeds** ellipsoid, 2–2.5 × 1–1.5 cm.

Vernacular names. Kalimantan—*nato hitam* (Malay), *natu hitam* (Bandjar).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, distributed mainly in the east coast districts (Lahad Datu and Kinabatangan, e.g., *SAN 22890*, *SAN 29390*, *SAN 100432*, and *SAN 121974*). In Sarawak, recorded from the 4th Division (Bintulu and Tubau R., e.g., *S 15913* and *S 18375*).

Ecology. In primary lowland and hill mixed dipterocarp forests on sandy loam or clay-rich soils, at altitudes to 450 m. Sometimes also occur in fresh water swamp forest.

Uses. The timber is of commercial value. The fruits are edible.

3. **Payena gigas** A.Bruggen

(Latin, *gigas* = a giant; the large-sized tree)

Blumea 9 (1958) 108; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 327. **Type:** *Clemens 27452*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes BM, BO, G, K).

Tree to 40 m tall, 105 cm diameter. **Bark** greyish to brown, finely fissured; inner bark red-brown. **Sapwood** yellow to whitish. **Twigs** (young) slender, terete, densely tomentose. **Stipules**

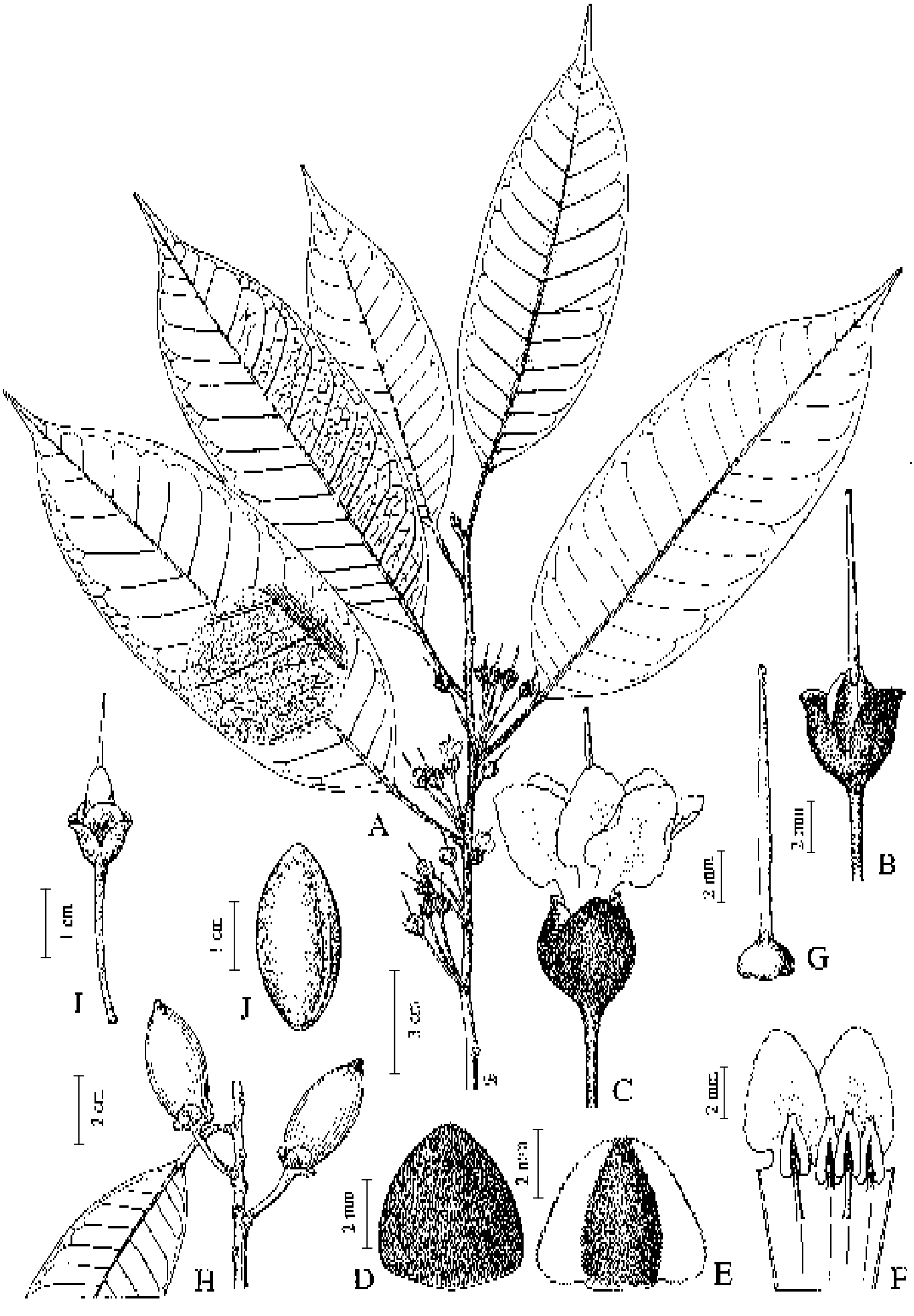

Fig. 22. *Payena ferruginea*. A, flowering leafy twig; B, flower bud; C, mature flower with petals protruding from the calyx; D, outer sepal; E, inner sepals; F, a section of corolla with four stamens attached; G, pistil; H, fruiting leafy twig; I, young fruit; J, seed. (A–G from *SAN 47698*, H and J from *SAN 31640*, I from *SAN 22890*.)

caducous, *narrowly triangular*, *6–10 × 1.5–2.5 mm*, densely tomentose. **Leaves** chartaceous to coriaceous, *glabrous on both surfaces*; broadly elliptic, *20–35 × 8–14 cm*, base rounded to oblique, apex acuminate, acumen 1–1.5 cm long; midrib sunken and glabrous above, prominent and tomentose beneath; *lateral veins* 30–32 pairs, at an angle of 70–80° with midrib, flat or sunken and glabrous above, raised, prominent and sparsely tomentose beneath, *arching and joining to form vein-loops near leaf margin*; intercostal venation faint on both sides; petiole 4–5.5 cm long, 3–4 mm thick, densely tomentose to subglabrous. **Inflorescences** axillary, 3–8-flowered. **Flowers:** pedicel 30–60 mm long, 1.5–2 mm thick, minutely hairy; outer sepals broadly ovate, 7–8 × 6–7 mm, tomentose, inner sepals broadly ovate, 5–7 × 8–9 mm, tomentose; corolla lobes broadly ovate, 5–6 × 4–5 mm, glabrous, corolla tube 4–5 mm long, glabrous; stamens 16, in one whorl, filaments *c.* 0.5 mm long, glabrous, anthers *c.* 3 mm long, glabrous; ovary *c.* 3 mm across, glabrous, style *c.* 15 mm long, glabrous. **Fruits** drying black, ovoid, 4–4.5 × 2–3 cm, *glabrous*; persistent outer sepals 8–10 × 9–10 mm, persistent inner sepals 7–8 × 9–10 mm; persistent style to 15 mm long; *stalk 5–6 cm long*, *c.* 1.5–2 mm thick, subglabrous. **Seeds** ellipsoid with a broad base, 3.5–4.5 × 2–2.5 cm; scar 0.3–1.3 cm wide.

Distribution. Endemic to Borneo and known only from Sabah (Ranau area including Mt. Kinabalu and Trus Madi in the Tambunan district, e.g., *Clemens 26330*, *Clemens 27316*, *Clemens 51322*, and *SAN 61874*).

Ecology. In hill mixed dipterocarp to lower montane forest, at 850–1220 m above sea level.

Uses. The fruits are reported to be edible.

4. **Payena grandistipula** J.T.Pereira Fig. 23.

(Latin, *grandis* = large, *stipula* = stipules; with large stipules)

Kew Bull. 52 (1997) 908. **Type:** *Ismawi et al. S 43621*, Borneo, Sarawak, 7th Division, Ulu Belaga, Semawat R. (holotype SAR; isotypes K, KEP, L, SAN).

Tree to 20 m tall, 30 cm diameter. **Bark** shallowly fissured. **Twigs** (young) hairy. **Stipules** *large*, *persistent*, *ovate* to *suborbicular*, *15–25 × 10–15 mm*, hairy. **Leaves** coriaceous, *glabrous on both surfaces* or *sparsely brown-hairy beneath*; broadly elliptic or oblong, *22–32 × 8–12 cm*, base rounded to shortly attenuate, apex acuminate, acumen 0.5–1 cm long; midrib slightly raised and glabrous above, prominent and sparsely hairy beneath; *lateral veins* 30–35 pairs, at an angle of 75–85° with midrib, obscure and glabrous above, prominently raised and hairy beneath, *joining to form a distinct smooth vein parallel to leaf margin*; intercostal venation faint above, prominent beneath; petiole 2–3 cm long, 3–3.5 mm thick, sparsely hairy. **Flowers** unknown. **Fruits** ovoid, 3.5–4 × 1.6–2.5 cm, apex gradually tapering to a sharp point, *brown velvety-hairy*; persistent outer sepals 9–10 × 10–12 mm, persistent inner sepals 9–10 × 10–11 mm; persistent style to 20 mm long; *stalk 8–10 cm long*, 2.5–3 mm thick, subglabrous. **Seeds** ellipsoid, *c.* 2 × 0.7 cm.

Distribution. Endemic to Borneo (Sarawak only). Known only from the locality of the type specimen.

Ecology. In riparian forest.

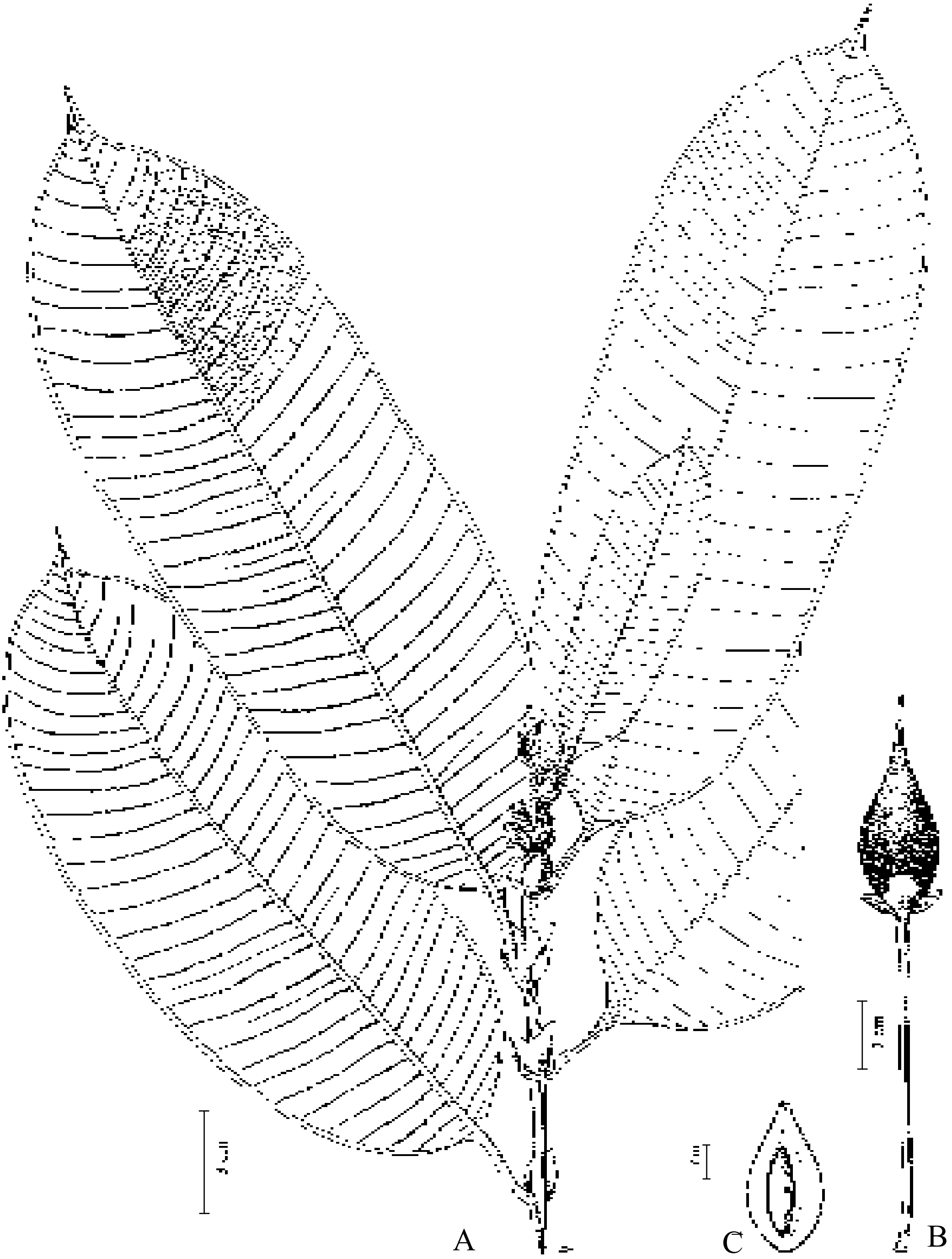

Fig. 23. *Payena grandistipula*. A, leafy twig with prominent stipules; B, fruit; C, longitudinal section of fruit. (All from *S 43621*.)

5. **Payena kapitensis** J.T.Pereira Fig. 24.

(of Kapit, Sarawak)

Kew Bull. 52 (1997) 910. **Type:** *Gary S 37211*, Borneo, Sarawak, 7th Division, Kapit, Balleh, Ulu Melinau R. (holotype SAN; isotypes K, KEP, L, SAR).

Tree to 35 m tall, 45 cm diameter. **Bark** dark brown, flaky. **Twigs** (young) *rusty-tomentose.* **Stipules** ovate, 2–3 × 2–3 mm, densely tomentose. **Leaves** subcoriaceous, *glabrous on both surfaces*; narrowly elliptic, *10–15 × 3.5–5 cm*, base slightly rounded or oblique, apex acuminate, *acumen 0.5–1 cm long*; *midrib* flat and glabrous to tomentose above, prominent and *sparsely tomentose beneath*; *lateral veins* 12–18 pairs, at an angle of 70–80° with midrib, glabrous on both sides, *faint beneath*, *joining to form a smooth vein parallel to leaf margin*; intercostal venation obscure on both sides; *petiole* 2–3 cm long, 1.5–2 mm thick, *tomentose*. **Inflorescences** axillary or borne on leafless nodes, 2–4-flowered. **Flowers:** *pedicel 20–30 mm long*, *c.* 1 mm thick, densely rusty-tomentose; outer sepals broadly ovate, 7–9 × 6–7 mm, densely rusty-tomentose, inner sepals narrowly ovate, 8–10 × 5–6 mm, densely rusty-tomentose; *corolla lobes* narrowly ovate, tapering at apex, 6–7 × 2–3 mm, *glabrous*, corolla tube 6–7 mm long, glabrous; stamens in one whorl, *filaments c.* 0.5 mm long, *glabrous*, anthers 2–3 mm long, glabrous; *ovary 3–4 mm acros*s, *hairy*, *style* 18–20 mm long, *hairy at its basal half.* **Fruits** unknown.

Distribution. Endemic to Borneo (Sarawak). Known from the type collection only.

Ecology. In mixed dipterocarp forest, on ridge top.

6. **Payena khoonmengiana** J.T.Pereira Fig. 25.

(Wong Khoon Meng, former forest botanist at Kepong, Brunei and Sandakan)

Kew Bull. 52 (1997) 912. **Type:** *Mat-Salleh KMS 3313*, Borneo, Sabah, Kinabatangan district, Bt. Tawai FR (holotype SAN; isotypes A, BO, K, KEP, L, SAR, SING).

Tree to 15 m tall, 13 cm diameter. **Bark** reddish brown, fissured to smooth; inner bark brown. **Sapwood** cream. **Twigs** (young) *tomentose*. **Stipules** caducous. **Leaves** *thickly coriaceous*, glabrous above, *sparsely brown tomentose* or *glabrous beneath*; ovate to elliptic, *7–10 × 3.5– 5 cm*, base rounded, apex acuminate, *acumen 1–1.5 cm long*; *midrib* flat to slightly raised and glabrous to tomentose above, raised, prominent and *tomentose beneath*; *lateral veins* 10–14 pairs, at an angle of 60–70° with midrib, obscure and glabrous above, *prominent* and tomentose *beneath*, *arching and joining to form vein-loops near leaf margin*; *intercostal venation obscure on both sides*; *petiole* 1.5–2.5 cm long, 1.5–2 mm thick, *tomentose*. **Inflorescences** axillary or borne on leafless nodes, 1–2-flowered. **Flowers** (immature)**:** *pedicel 25–30 mm long*, *c.* 1 mm thick, subglabrous; *outer sepals* thick, broadly ovate, 6–7 × 6–7 mm, *sparsely sericeous*, inner sepals ovate, *c.* 7 × 8–9 mm, sparsely sericeous; *corolla lobes* broadly elliptic or oblong, 4–5 × 1–2.5 mm, *glabrous*, corolla tube 1–1.5 mm long, glabrous; *stamens in one whorl*, glabrous, *filaments c*. 0.5 mm long, *glabrous*, anthers 2.5–3 mm long; *ovary 1.5–2 mm across*, *glabrous*, *style* 6–14 mm long, *glabrous*. **Fruits** (young) *very narrowly ovoid*, 3–4 × 0.7–0.8 cm, *gradually tapering to a sharp point*, glabrous; persistent outer sepals, 6–7 × 6–8 mm, persistent inner sepals 6–7 × 8–10 mm; persistent style to 1 cm long; stalk slender, 3.5–4 cm long, 1–1.5 mm thick, glabrous. **Seeds** unknown.

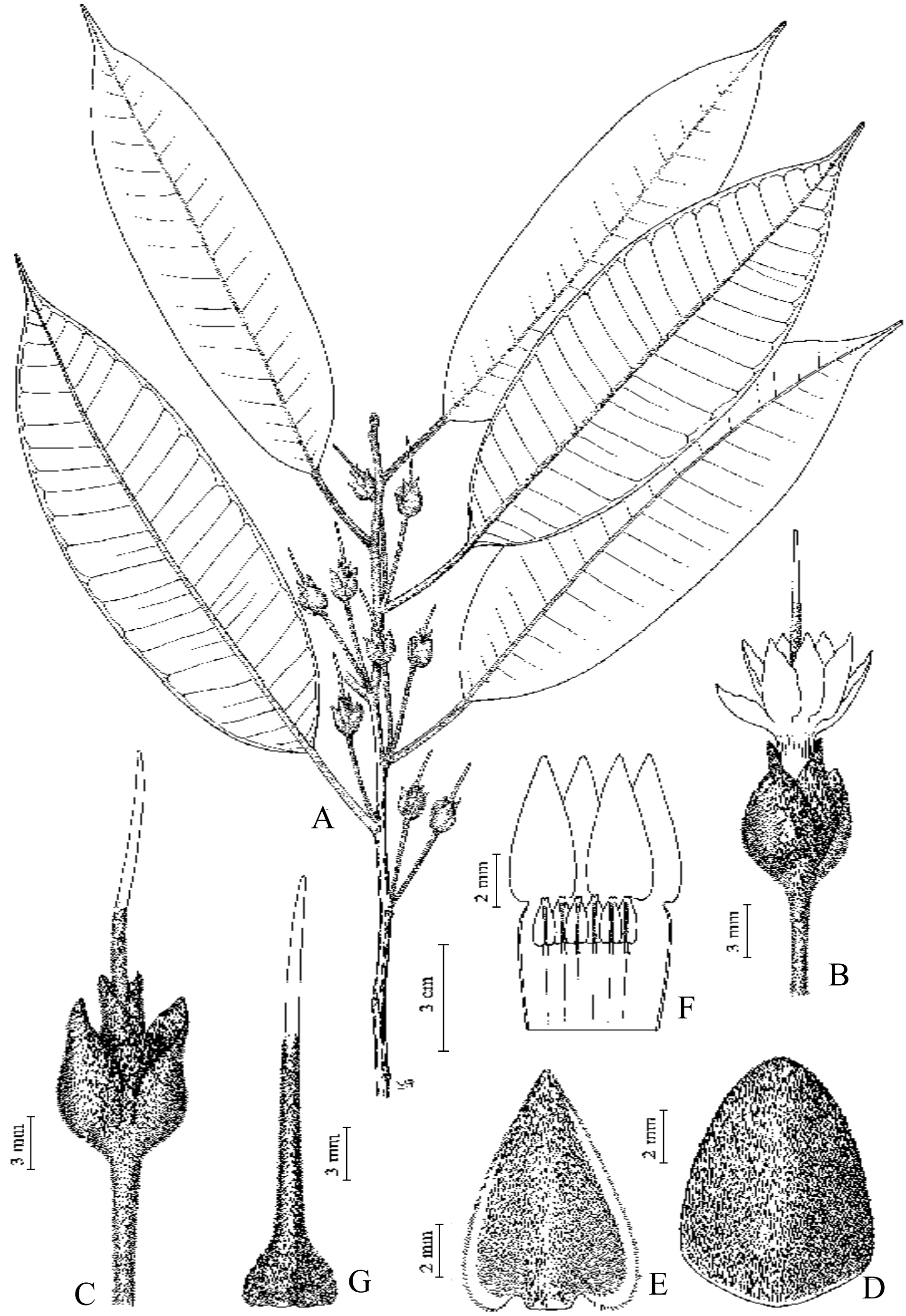

Fig. 24. *Payena kapitensis*. A, flowering leafy twig; B, mature flower with petals protruding from the calyx; C, mature flower with petals removed; D, outer sepal; E, inner sepal; F, a section of corolla with six stamens attached; G, pistil. (All from *S 37211*.)

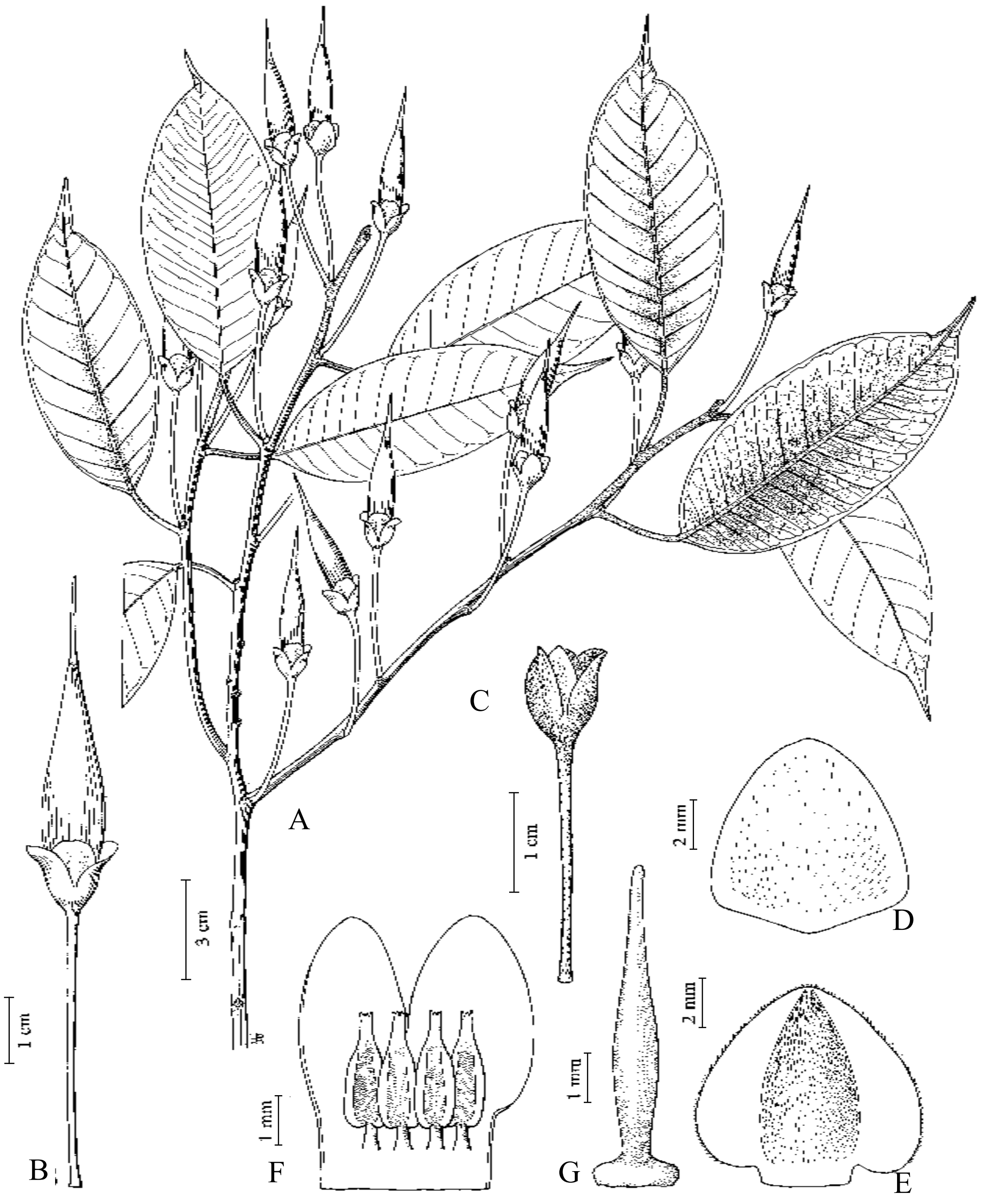

Fig. 25. *Payena khoonmengiana*. A, fruiting leafy twig; B, young fruit; C, flower bud; D, outer sepal; E, inner sepal; F, a section of corolla showing four stamens attached; G, pistil. (A–B from *Mat-Salleh KMS 3313*, C–G from *Zainuddin AZ 5048*.)

Distribution. Endemic to Borneo (Sabah), so far only known from two collections (*Mat-Salleh KMS 3313* and *Zainuddin AZ 5048*) from Bt. Tawai, Kinabatangan district.

Ecology. In lowland forest on ultramafic soils, near waterfalls, at about 480 m altitude.

7. **Payena kinabaluensis** J.T.Pereira Fig. 26.

(of Mt. Kinabalu, Sabah)

Kew Bull. 52 (1997) 914. **Type:** *Clemens 26329*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype K; isotypes L, SING).

Tree to 20 m tall. **Twigs** (young) *subglabrous*. **Stipules** *ovate*, *c.* 2 × *1.5–2 mm*, subglabrous. **Leaves** subcoriaceous to chartaceous, glabrous to appressed hairy and *not white-waxy above*, *sparsely appressed brown-hairy beneath*; narrowly to broadly elliptic-oblong, *12–20 × 3.5–7 cm*, base slightly rounded to oblique, apex acuminate, *acumen 1–1.5 cm long*; *midrib* slightly raised and glabrous to sericeous above, distinct and *subglabrous* to *sericeous beneath*; *lateral veins* 15–20 pairs, at an angle of 60–70° with midrib, obscure and glabrous on both sides, *arching and joining to form vein-loops near leaf margin*; intercostal venation obscure on both sides; *petiole* 2–3 cm long, *2–3 mm thick*, *subglabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 2–7-flowered. **Flowers** (immature)**:** *pedicel 30–35 mm long*, *1–1.5 mm thick*, sparsely sericeous; *outer sepals* broadly ovate, *5–7* × 7–8 mm, sparsely hairy, *inner sepals* broadly ovate, *5–6* × 8–8.5 mm, sericeous; *corolla lobes* ovate, *6–7* × 4.5–5 mm, *glabrous*, *corolla tube 0.5–1 mm long*, glabrous; *stamens in one whorl*, *filaments* 0.5–1 mm long, *glabrous*, *anthers* 3.5–4 mm long, *glabrous*; ovary *c.* 2 mm across, glabrous, *style 6–10 mm long*, glabrous. **Fruits** *ovoid*, *2.5–3 × 1–1.5 cm*, gradually tapering to a sharp point at apex, glabrous; persistent outer sepals 7–9 × 8–10 mm, *persistent inner sepals 6–7* × 9–10 mm; persistent style to 20 mm long; *stalk 5–6 cm long*, *c.* 1.5 mm thick, glabrous. **Seeds** ellipsoid, *1–1.5 × 0.7 cm*.

Distribution. Endemic to Borneo (Sabah). Only known from the type collection.

Ecology. In primary mixed dipterocarp forest, at about 900 m altitude.

8. **Payena lamii** A.Bruggen

(H.J. Lam, 1892–1977, Dutch botanist)

Blumea 9 (1958) 127; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 327. **Type:** *Everett s.n.*, Borneo, Sarawak, Bintulu (holotype SAR; isotype L).

Tree to 15 m tall, 20 cm diameter. **Bark** smooth, lenticellate. **Twigs** (young) slender, terete, appressed rusty-hairy. **Leaves** subcoriaceous to coriaceous, *glabrous on both surfaces*; ovate-oblong, *12–19 × 4.5–7 cm*, base cuneate to subequal rounded, apex acuminate, *acumen 2–3 cm long*; midrib raised and glabrous above, prominently raised and hairy to glabrous beneath; lateral veins 20–32 pairs, at an angle of 60–80° with midrib, glabrous, flat and obscure above, prominently raised beneath, joining to form a smooth vein parallel to leaf margin; intercostal venation invisible above, faint beneath; petiole 2.5–4.5 cm long, 1.5–2 mm thick, glabrous. **Inflorescences** axillary or borne on leafless nodes, 7–10-flowered. **Flowers:** *pedicel 2–3 mm*

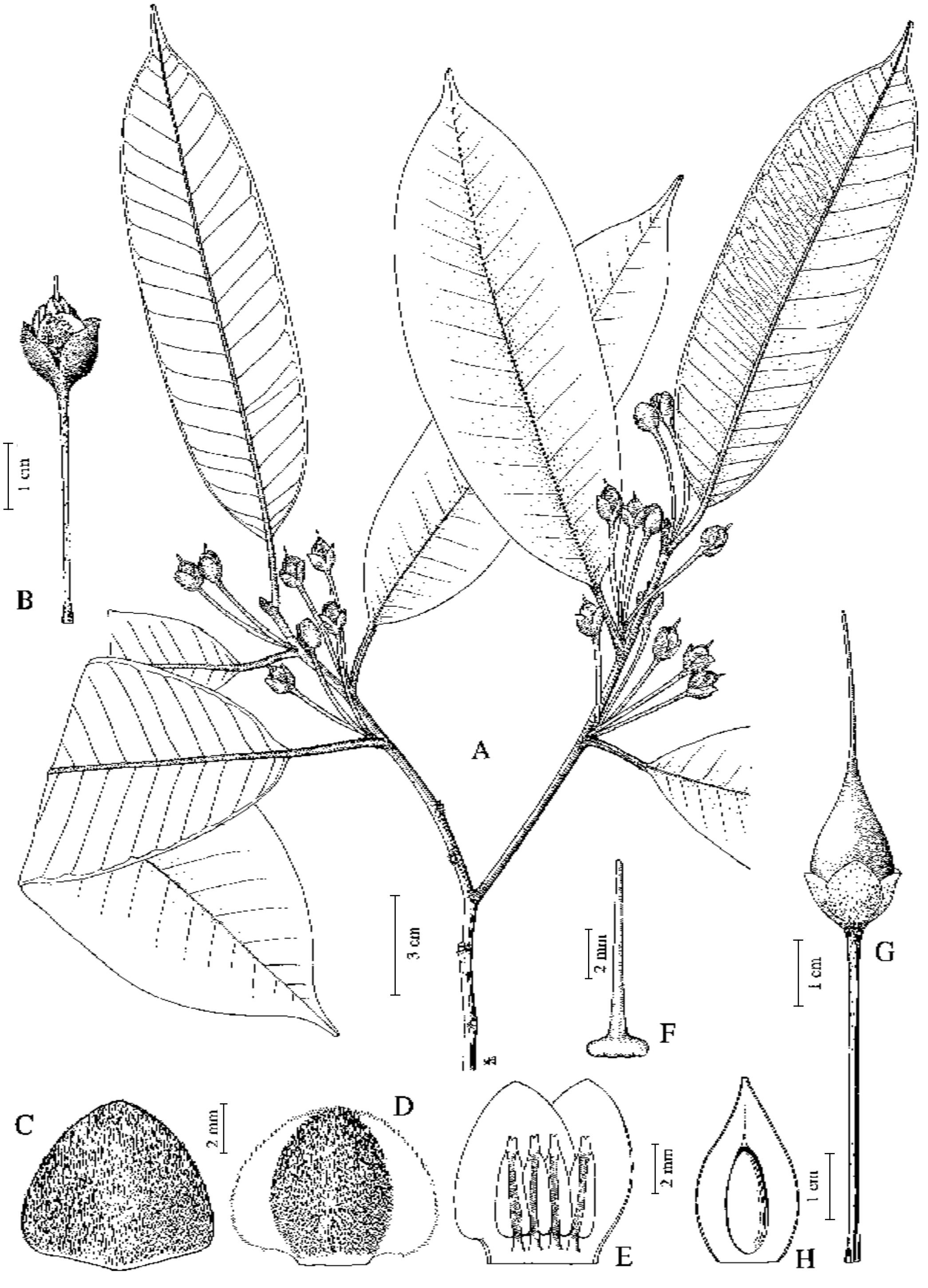

Fig. 26. *Payena kinabaluensis*. A, flowering leafy twig; B, flower bud; C, outer sepal; D, inner sepal; E, a section of corolla showing four stamens attached; F, pistil; G, fruit; H, longitudinal section of fruit. (All from *Clemens 26329*.)

long, *c.* 1 mm thick, hairy; outer sepals ovate, 4–4.5 × 3–4 mm, pubescent, inner sepals ovate, 4–4.5 × 3.5–4 mm, appressed yellowish brown hairy; *corolla lobes* ovate-oblong, 2.5–3 × 1–1.5 mm, *hairy along longitudinal median parts*, corolla tube 2–2.5 mm long, hairy; stamens 16, in one whorl, *filaments c.* 1 mm long, *densely hairy*, anthers 1.5–2 mm long, hairy; ovary *c.* 1 mm across, hairy, style 7–10 mm long, glabrous. **Fruits** broadly ellipsoid, *c.* 3 × 2–2.5 cm, abruptly terminated by a slender style, sparsely hairy; persistent outer sepals 5–6 × 4–5 mm, persistent inner sepals 6–7 × 4–5 mm; persistent style *c.* 15 mm long; stalk 1.8–2 cm long, 1–1.5 mm thick, glabrous to sparsely hairy. **Seeds** ellipsoid, 2–2.5 × 1.2–1.5 cm.

Vernacular names. Sarawak—*nyato berlali* (Bintulu area), *nyatoh padang* (Sibu area).

Distribution. Endemic to Borneo (Sarawak). Uncommon, so far only known from four collections, i.e. *S 25695* from Bt. Sejarak, Lundu district, *S 2722* and *S 2768* from Sibu district, and *Everett s.n.* (type) from Bintulu district.

Ecology. In peat swamp and *kerangas* forests, at altitudes to 250 m.

9. **Payena leerii** (Teijsm. & Binn.) Kurz

(J.M. van Leer, 1812–?, Dutch physician)

J. As. Soc. Beng. 40, 2 (1871) 69; Merrill *l.c.* (1921) 477; Ridley *l.c.* 263; H.J. Lam *l.c.* (1925) 137, 261, *l.c.* (1927) 437; Burkill *l.c.* 1678; Masamune *l.c.* 599; Browne *l.c.* 322; Backer & Bakhuizen *f. l.c.* 192; Smythies *l.c.* 126; Burgess *l.c.* 448; A. Bruggen *l.c.* 121; Ng *l.c.* 432; Anderson, Trees of Peat Swamp Forests of Sarawak (1972) 174, *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; PROSEA *l.c.* 340; Turner *l.c.* 467; Argent *et al.* (eds.) *l.c.* 588. **Basionym:** *Azaola leerii* Teijsm. & Binn., Nat. Tijdschr. Ned.-Indie 6 (1854) 116. **Neotype** (A. Bruggen, 1958)**:** *Teijsmann, s.n.* (= *Herbarium Hance 13935*), Sumatra (holoneotype BM). **Synonyms:** *Keratophorus leerii* (Teijsm. & Binn.) Hassk. *l.c.* 579; *Hapaloceras leerii* (Teijsm. & Binn.) Hassk. *l.c.* 639; *Madhuca leerii* (Teijsm. & Binn.) Merr., Enum. Phil. Fl. Pl. 3 (1923) 277; *Isonandra ?benjamina* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 310; *Payena benjamina* (de Vriese) Pierre, Bull. Mens. Soc. Linn., Paris 1 (1885) 524; *P. beccarii* Pierre *l.c.* 525; *P. parvifolia auct. non* Engl.: Merrill *l.c.* (1921) 477.

Tree to 30 m tall, 60 cm diameter, buttresses low and spreading. **Bark** greyish brown, slightly fissured to finely cracked; inner bark reddish brown. **Sapwood** pale orange to white. **Twigs** (young) slender, terete, *densely rusty-sericeous*. **Stipules** triangular, *c.* 1.5 × 0.5–1 mm, densely rusty-sericeous. **Leaves** chartaceous to coriaceous, *glabrous on both surfaces*, *white-waxy above*; ovate to narrowly elliptic, *4.5–10 × 2–5 cm*, base rounded, apex short-acuminate, *acumen* (*0.5–*)*1–2 cm long*; *midrib* slightly raised and glabrous to rusty appressed-hairy above, raised and *rusty sericeous beneath*; lateral veins 10–16 pairs, at an angle of 65–75° with midrib, obscure and glabrous on both sides, joining to form a smooth vein parallel to leaf margin; intercostal venation invisible above, faint beneath; *petiole* 0.5–1.5 cm long, 0.5–1 mm thick, *rusty sericeous*. **Inflorescences** *axillary*, *mostly on distal end of twigs*, 1–8-flowered. **Flowers:** *pedicel 5–20 mm long*, 0.5–1 mm thick, rusty appressed-hairy; outer sepals triangular to ovate, 3–5 × 3–4 mm, rusty hairy, inner sepals narrowly ovate, 3–5 × 3–5 mm, densely rusty-hairy; *corolla lobes* narrowly to broadly ovate, 3–5 × 1–2 mm, *glabrous*, corolla tube 1–2 mm long, sometimes with hairs at outer base; stamens 16, in one whorl, *filaments c.* 0.5 mm long, *glabrous*, anthers 1.5–3 mm long, hairy; ovary 1.5–2 mm across, densely hairy, style 6–8.5 mm long, glabrous. **Fruits** *conical*, (2–)3–4 × 1–1.5 cm, sparsely appressed rusty-hairy to glabrous; persistent outer sepals

4–5 × 4–5 mm, persistent inner sepals 4–5 × 3.5–5 mm; persistent style to 10 mm long; stalk 1–2 cm long, *c.* 1 mm thick, subglabrous to glabrous. **Seeds** ellipsoid, 2–2.5 × 0.8–1 cm; scar 0.1–0.2 cm wide.

Vernacular names. Sarawak—*nyatoh burung*, *nyatoh cabi*, *nyatoh kabang*, *nyatoh pipit* (Kuching area).

Distribution. A widespread species in W Malesia, extending from Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan) to the Philippines. In Sabah, restricted to the west coast (e.g., *Cuadra 2436*, *SAN 57538*, *SAN 60558*, and *SAN 102976*), whereas in Sarawak mainly occurring in the 1st Division, rarely in 2nd and 4th Divisions (e.g., *S 10129*, *S 13484*, *S 29910*, *S 42179*, and *S 48702*).

Ecology. In coastal lowland forest, typically in mixed swamp forest and *kerangas* forest, on sandy podsolic soils, at altitudes to 650 m.

Uses. *P. leerii* has been grouped under *nyatoh batu* (Burgess *l.c.* 449, 453). It produces good quality gutta percha. The fruits are edible.

10. **Payena longipedicellata** Brace *ex* King & Gamble

(Latin, *longipedicellatus* = with a long pedicel; the flower)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 169; Merrill *l.c.* (1921) 477; Ridley *l.c.* 262; H.J. Lam *l.c.* (1925) 148; Masamune *l.c.* 599; A. Bruggen *l.c.* 115; Ng *l.c.* 432; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; Turner *l.c.* 467; Coode *et al.* (eds.) *l.c.* 308. **Lectotype** (A. Bruggen, 1958)**:** *King's Collector 2940*, Peninsular Malaysia, Perak, Larut (K).

Tree to 30 m tall, 60 cm diameter. **Bark** black, cracked. **Sapwood** yellow. **Twigs** (young) slender, terete, *glabrous* to *sericeous*. **Stipules** *triangular*, 2–2.5 × *1–1.5 mm*, appressed hairy. **Leaves** subcoriaceous, *glabrous on both surfaces*, *not white-waxy above*; ovate to narrowly elliptic, *7.5–13* × *3–5 cm*, base unequally rounded, apex short-acuminate, *acumen 0.3–0.7*(*–1.5*) *cm long*; *midrib* flat and glabrous above, prominently raised and *glabrous* to *subglabrous beneath*; *lateral veins* 10–18 pairs, at an angle of 60–70° with midrib, glabrous and obscure above, glabrous and prominent beneath, *arching and joining to form vein-loops near leaf margin*; intercostal venation invisible above, faint beneath; *petiole* 1.5–3.5 cm long, 1–1.5 mm thick, *glabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 1–3-flowered. **Flowers:** *pedicel 25–45 mm long*, *c.* 1 mm thick, minutely hairy; *outer sepals* broadly ovate, apex acute to obtuse, *7–12* × 7–10 mm, sparsely hairy, *inner sepals* broadly ovate, *8–13* × 7–12 mm, apex acuminate, sparsely hairy; *corolla lobes 8–12* × 2.5–4 mm, *glabrous*, corolla tube *c.* 8 mm long, glabrous; *stamens* 16, *in two whorls*, alternate ones covered by the others, *filaments c.* 0.5–1 mm long, *glabrous*, *anthers* 3–4 mm long, *hairy*, bifid at apex; ovary *c.* 3 mm across, hairy, style 14–30 mm long, hairy to its basal half. **Fruits** *ovoid*, 2.5–3 × 2–2.5 cm, gradually tapering to a sharp point, subglabrous; *persistent inner sepals c. 10* × 5 mm; persistent style to 15 mm long; *stalk c. 3.5 cm long*, 1–1.5 mm thick, subglabrous. **Seeds** ellipsoid, *c.* 1.5 × 0.5 cm.

Distribution. Peninsular Malaysia (one collection, *King's Collector 2940*) and Borneo (Sabah and Sarawak), uncommon. In Sabah, recorded only from Beaufort district (e.g., *SAN 31812*) whereas in Sarawak occurs in Kuching Division (e.g., *Haviland 3035*).

Ecology. In lowland mixed dipterocarp forest on hilly areas.

11. **Payena microphylla** (de Vriese) Pierre

(Greek, *mikro* = small, *phullon* = leaf; small-leaved)

Bull. Mens. Soc. Linn., Paris 1 (1885) 531; Burck *l.c.* 60; Merrill *l.c.* (1921) 477; H.J. Lam *l.c.* (1925) 136; A. Bruggen *l.c.* 120; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; Pennington *l.c.* 160; Coode *et al.* (eds.) *l.c.* 308; Pereira *l.c.* 918; Argent *et al.* (eds.) *l.c.* 589. **Basionym:** *Isonandra microphylla* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 312. **Type:** *Motley 203*, Borneo, Kalimantan, Banjarmasin (BO, K, L, P). **Synonyms:** *P. endertii auct. non* H.J.Lam: A. Bruggen *l.c.* 124, *p.p.* (specimens of Borneo); *P. obscura auct. non* Burck: A. Bruggen *l.c.* 117, *p.p.* (specimens of Borneo); *P. leerii auct. non* (Teijsm. & Binn.) Kurz: A. Bruggen *l.c.* 121, *p.p.* (specimens of Borneo); *P. lucida auct. non* (Wall. *ex* G.Don) A.DC.: A. Bruggen *l.c.* 111, *p.p.* (specimens of Borneo).

Tree to 45 m tall, 160 cm diameter, buttresses to 5 m high. **Bark** black to reddish brown, deeply fissured to scaly; inner bark reddish brown. **Sapwood** yellow to white. **Twigs** (young) slender, terete, *sericeous*. **Stipules** narrowly triangular to linear, 2.5–8 × *0.5–1 mm*, appressed hairy. **Leaves** subcoriaceous to chartaceous, glabrous and *not white-waxy above*, *glabrous* to *sparsely sericeous beneath*; ovate or elliptic-oblong, *5–15 × 2–6 cm*, base cuneate to rounded, sometimes oblique, apex acuminate, *acumen 0.2–1.5 cm long*; *midrib* slightly raised and glabrous above, distinct and *glabrous* to *sericeous beneath*; *lateral veins* 10–25 pairs, at an angle of 50–70° with midrib, glabrous, faint, above, prominent to obscure beneath, *joining to form a smooth vein parallel to leaf margin*; intercostal venation obscure above, prominent to obscure beneath; *petiole* 0.5–2 cm long, 1–2 mm thick, *glabrous* to *subglabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 2–15-flowered. **Flowers:** *pedicel 5–20 mm long*, 0.2–1 cm thick, appressed hairy; outer sepals broadly ovate, 2–5 × 3–6 mm, appressed hairy, inner sepals broadly ovate, 2.5–5 × 3–6 mm, appressed hairy; *corolla lobes* elliptic, 2–6 × 1.5–3 mm, *glabrous*, corolla tube 2–6 mm long, glabrous; stamens 16, in one whorl, *filaments* in bundles, 0.5–2 mm long, *glabrous*, anthers 1–3 mm long, glabrous; ovary 1.5–2.5 mm across, glabrous to hairy, style 6–18 mm long, glabrous. **Fruits** *ovoid* to *ovoid-ellipsoid*, 2–4 × 1–2 cm, drying black, glabrous; persistent outer sepals recurved, 2.5–3.5 × 2.5–4 mm, *persistent inner sepals 3.5–4* × 3.5–5 mm; persistent style to 15 mm long; *stalk 0.5–2 cm long*, 1.5–2 mm thick, subglabrous. **Seeds** ellipsoid, *c.* 2 × 1 cm.

Vernacular names. Sarawak—*pulut badan* (Kelabit). Kalimantan—*nato mergatakan* (Pleihari area).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). Common and widespread in Sabah (e.g., *Clemens 26715*, *Beaman 7634*, *RSNB 4323*, *SAN 42880*, and *SAN 132813*) and Sarawak (e.g., *S 17734*, *S 22374*, *S 33765*, and *S 38842*).

Ecology. In lowland mixed dipterocarp forest on various types of soils to montane forest, at altitudes to 2000 m.

12. **Payena obscura** Burck

(Latin, *obscurus* = indistinct, obscure; the leaf with obscure veins)

Ann. Jard. Bot. Buitenz. 5 (1886) 60; Merrill *l.c.* (1921) 477; Ridley *l.c.* 263; H.J. Lam *l.c.* (1925) 150, *l.c.* (1927) 435; Masamune *l.c.* 598; Wyatt-Smith, FRI Res. Pamphl. 4 (1954) 51; A. Bruggen *l.c.* 117; Ng *l.c.*

433; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; PROSEA *l.c.* 338; Pennington *l.c.* 160; Turner *l.c.* 467; Coode *et al.* (eds.) *l.c.* 308; Pereira *l.c.* 916. **Type:** *Burck s.n.* (= *Herbarium Bogoriense No. 151344*), Sumatra, Pangkalan (BO).

Tree to 30 m tall, 90 cm diameter, buttresses concave to 1.5 m high. **Bark** dark brown to greyish brown, fissured to flaky; inner bark brown. **Sapwood** yellow to white. **Twigs** (young) slender, terete, *sericeous*. **Stipules** *ovate*, 1.5–2.5 × *1.5–2 mm*, golden-brown hairy. **Leaves** coriaceous to chartaceous, glabrous and *not white-waxy above*, *sparsely appressed brown-hairy* to *glabrous beneath*; ovate, obovate to narrowly elliptic or oblong, *6–16* × *2.5–7 cm*, base cuneate, rounded to attenuate, apex short-acuminate, *acumen 0.3–2 cm long*; *midrib* flat and glabrous above, prominent and *sericeous* to *glabrous beneath*; *lateral veins* 12–20 pairs, at an angle of 60–70° with midrib, glabrous, obscure above, faint below, *arching and joining to form vein-loops near leaf margin*; intercostal venation faint on both sides; *petiole* 1–3.5 cm long, (*1–*)*1.5–2 mm thick*, *subglabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 1–9-flowered. **Flowers:** *pedicel 20–35 mm long*, *0.5–1 mm thick*, hairy; *outer sepals* broadly ovate, *4–7* × 5–8 mm, appressed hairy, *inner sepals* broadly ovate, *4–7.5* × 5–8 mm, appressed hairy; *corolla lobes* oblong to ovate, *5–9* × 2–5 mm, *glabrous*, *corolla tube 3–6 mm long*, glabrous; *stamens* 16, *in one whorl*, *filaments* 0.5–2 mm long, *glabrous*, *anthers* 2–3.5 mm long, *glabrous*, lacerate to acuminate at apex; ovary 1.5–3 mm across, glabrous to hairy, *style 12–20 mm long*, glabrous or hairy to one third from base only. **Fruits** *ovoid* to *narrowly ovoid*, *4–5* × *1.5–2.5 cm*, gradually tapering into a sharp point, glabrous to subglabrous; *persistent outer sepals 5–8* × 5–10 mm, *persistent inner sepals 5–8* × 6–10 mm; persistent style to 20 mm long; *stalk 2.5–4 cm long*, 1.5–4 mm thick, glabrous. **Seeds** ellipsoid, *2–3* × *1–1.5 cm*; scar 0.3–0.4 cm wide.

Uses. The latex produces gutta percha.

Key to varieties

Outer sepals 4–5 mm long. Ovary glabrous. Fruit stalk 1.5–1.8 mm thick. Persistent outer sepals 5–7 mm wide..

var. **havilandii** (King & Gamble) J.T.Pereira

(J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Kew Bull. 52 (1997) 916. Basionym: *Payena havilandii* King & Gamble *l.c.* 169, *p.p.* (specimens from Borneo), Ridley *l.c.* 263, H.J. Lam *l.c.* (1925) 136. Lectotype (Pereira, 1997): *Haviland 2320*, Borneo, Sarawak, near Kuching (K).

Endemic to Borneo (Sabah, Sarawak and Brunei). In Sarawak, collected from the 1st and 2nd Divisions (e.g., *S 13386*, *S 37844*, *S 37918*, and *S 43975*). In Sabah, only known from one collection, *Clemens 11258*, from Tuaran. In lowland mixed dipterocarp forest, on sandy-clay soils, at altitudes to 850 m.

Outer sepals 5–7.5 mm long. Ovary hairy. Fruits stalk 2–3.5 mm thick. Persistent outer sepals 7–10 mm wide..

var. **obscura**

Synonym: *Payena havilandii* King & Gamble *l.c.* 169, *p.p.* (specimens from Peninsular Malaysia and Singapore).

Widespread. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak and Brunei). In Sabah, mainly collected from the west coast (Papar, Beaufort and Sipitang districts; e.g., *SAN 16832*, *SAN 34530*, *SAN 35099*, *SAN 66731*, and *SAN 108534*), rarely in the east coast (two collections from Labuk-Sugut district, *SAN 73879* and *SAN 139024*). In

Sarawak, recorded from the 4th Division (Lambir Hills NP; e.g., *S 38423*, *S 38432*). From lowland to ridge *kerangas* forest, at altitudes to 1200 m. Vernacular names: Sabah—*nyatoh taban putih* (Sipitang). Brunei—*nyato* (Dusun, Iban), *nyatoh jangkar* (Dusun).

10. **POUTERIA** Aublet

(from a South American plant name)

Stephen P. Teo

Hist. Pl. Guiane 1 (1775) 85; Baehni, Candollea 9 (1942) 149; Herrmann-Erlee & P. Royen, Blumea 8 (1957) 453; Ng, TFM 1 (1972) 437; Anderson CLTS (1980) 320; Whitmore & Tantra, CLS (1986) 224; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 328; Pennington, Gen. Sapot. (1991) 184; PROSEA 5, 1 (1993) 362; Coode *et al.* (eds.), CLBD (1996) 308; Argent *et al.* (eds.), MNDT-CK 2 (1997) 589; Teo, Sar. Mus. J. 51 (1997) 211. **Synonyms:** *Lucuma* Molina, Saggio Chili (1782) 186, H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 219, *ibid.* 3, 8 (1927) 476; *Planchonella* Pierre, Not. Bot. Sapot. (1890) 34, H.J. Lam *l.c.* (1925) 193, *l.c.* (1927) 467, P. Royen, Blumea 8 (1957) 236, Backer & Bakhuizen *f.*, FJ 2 (1965) 189, Ng, TFM 1 (1972) 437, Anderson, CLTS (1980) 319, Whitmore & Tantra *l.c.* 224, Whitmore, Tantra & Sutisna *l.c.* 328.

Trees or shrubs. **Stipules** *absent.* **Leaves** *spirally arranged*, rarely subopposite, well-spaced along twigs or crowded at ends of twigs; *lateral veins well-spaced*, diminishing and becoming inconspicuous toward leaf margin or arching and joining to form intramarginal vein-loops; *intercostal venation reticulate* or *scalariform*. **Inflorescences** few-flowered fascicles, axillary or borne on leafless older twigs; fascicles solitary or occasionally clustered on leafless short shoots. **Flowers** unisexual (plant dioecious) or bisexual; *sepals* (*4–*)*5*(*–6*), *in a single whorl*, overlapping or free but joined at base; corolla cup-shaped or tubular, rarely rotate, lobes (4–)5(–6), not divided into segments, erect or rarely spreading, ciliate or papillose, tube shorter, equal or rarely longer than corolla lobes; stamens (4–)5(–6), in a single whorl, inserted on lower or upper half of corolla tube, or rarely at base of corolla lobes, included or rarely exserted, filaments short, anthers extrorsely or laterally dehiscent; *staminodes* (*4–*) *5*(*–6*), *rarely absent*, inserted in corolla lobes' sinuses or inside corolla tube; disk (nectary) present or absent; ovary 1–6-loculed, style stout, included or exserted, ovule placentation axile. **Fruit** a berry, 1–several-seeded. **Seeds** broadly ellipsoid, plano-convex; testa smooth, wrinkled or pitted; scar adaxial; cotyledons plano-convex or thin-foliaceous; endosperm present or absent.

Distribution. About 200 species, distributed in tropical America, C Africa, Asia, Malesia, Australia and the Pacific Islands. Ten including one incompletely known species are recorded from Sabah and Sarawak.

Ecology. Occurs in wide range of habitats, from coastal fringe forest to lower montane forest, at altitudes to 1700 m.

Taxonomy. Baehni (*l.c.* (1942) 149) united *Planchonella* and *Pouteria* into a single genus, and pointed out that the proportion between the amount of endosperm and the thickness of cotyledons was insufficient to separate the two genera. Subsequently, several authors (P. Royen *l.c.* 236, Herrman-Erlee & P. Royen *l.c.* 453, Ng *l.c.* 437, and Whitmore, Tantra & Sutisna *l.c.* 328) reinstated *Planchonella* as a distinct genus, differing from *Pouteria* by its thin foliaceous cotyledons, copious endosperm, and narrow linear seed scar. In *Pouteria* the cotyledons are thick, the endosperm is thin or lacking and the seed scar is broad. In addition, *Planchonella* has an Asiatic centre of distribution, whereas *Pouteria* has its centre of distribution in S America. Pennington (*l.c.* 184) made detailed comparative studies of all genera in the Sapotaceae and concluded that, based on the presence of many intermediate floral and other morphological characters, the two genera should be combined. Pennington's conclusion is accepted in the present account.

Key to *Pouteria* species

1. Leaves crowded near end of twigs.......................................**5. P. maclayana**
   Leaves well-spaced along twigs...2

2. Lateral veins arching and diminishing toward leaf margin.........................3
   Lateral veins straight or curved, arching and joining near leaf margin to form intramarginal vein-loops..5

3. Leaves glaucous below. Fruits densely rusty-brown appressed tomentose. Seed scar oblong..**7. P. malaccensis**
   Leaves not glaucous below. Fruits glabrous or sparsely rusty-brown tomentose. Seed scar linear..4

4. Leaf margin undulate and recurved; lateral veins closely spaced, 14–19 pairs, straight and parallel, arching and diminishing only near leaf margin; intercostal venation densely scalariform; petiole broadly but shallowly grooved on adaxial side. Inflorescences 2–5-flowered. Fruits 0.8–2.5 × 0.3–1.6 cm.............**2. P. firma**
   Leaf margin not undulate, plane; lateral veins well-spaced, 5–7(–11) pairs, subparallel, arching and diminishing toward leaf margin; intercostal venation laxly scalariform; petiole flat on adaxial side. Inflorescences up to 15-flowered. Fruits 2.5–4 × 2–3.5cm..**6. P. maingayi**

5. Intercostal venation reticulate...6
   Intercostal venation scalariform...8

6. Leaves lanceolate to narrowly elliptic; margin undulate and slightly recurved; petiole 0.4–1.2 cm long. Fruits with a ring of hirsute hairs at base; pericarp fleshy to slightly woody...**4. P. linggensis**
   Leaves obovate, obovate-elliptic to obovate-oblong; margin not undulate; petiole 1.5–2.5 cm long. Fruits glabrous; pericarp membranaceous.....................................7

7. Leaves glabrous on both surfaces, not shining above; apex broadly acute to shortly acuminate; intercostal venation laxly reticulate, without any vein descending from leaf margin and parallel to lateral veins. Sepals obovate; corolla lobes thick and fleshy, membranaceous around margin. Fruits ovoid-globose to ellipsoid-globose, 3–3.5 × 2–2.5 cm...**3. P. glabra**
   Leaves glabrous and shining above, initially densely reddish-brown tomentose below,

late-glabrescent, apex rounded; intercostal venation densely reticulate, with a few veins descending from leaf margin and parallel to lateral veins. Sepals broadly ovate to suborbicular; corolla lobes membranaceous throughout. Fruits obovoid or subglobose, 1–1.5 cm across……………………………………..………………**9. P. obovata**

8. Leaves membranaceous to chartaceous, on drying shining black on both surfaces; margin undulate. Inflorescences fascicled, borne on leafless to almost leafless axillary shoots to 12 cm long. Fruits obliquely fusiform or obovoid-globose…..…… ....**1. P. duclitan**
Leaves thickly coriaceous, drying yellowish brown, not shining; margin not undulate. Inflorescences axillary. Fruits ovoid…………………**8. P. mindanaensis**

1. **Pouteria duclitan** (Blanco) Baehni

(after a Philippines plant name)

Candollea 9 (1942) 283. **Basionym:** *Sideroxylon duclitan* Blanco, Fl. Filip. ed. 1 (1837) 129; Merrill, Spec. Blancoan. (1918) 301. **Neotype** (Merrill, 1918)**:** *Merrill Spec. Blancoan. 1*, the Philippines, Luzon, Manila (isoneotype NSW). **Synonyms:** *Sideroxylon balitbitan* Blanco *l.c.* 130; *S. nitidum* Blume, Bijdr. Fl. Ned. Ind. (1826) 675, Merrill *l.c.* (1921) 482; *Planchonella nitida* (Blume) Dubard, Ann. Mus. Colon. Marseille 20 (1912) 62, H.J. Lam *l.c.* (1925) 205, 245, 246, 266, *l.c.* (1927) 472, P. Royen *l.c.* (1957) 362; *Pouteria nitida* (Blume) S.P.Teo *l.c.* 217, *comb. inval.*, *non* (A.DC.) Radlk., Sitzb. Math.-Phys. Akad. Muench. 12 (1882) 333.

Tree to 50 m tall; bole fluted. **Bark** scaly; inner bark pale yellow. **Twigs** terete or sub-angular, 4–10 mm diameter. **Leaves** *well-spaced along twigs*, *membranaceous* to *chartaceous*, *on drying shining black on both surfaces*, initially reddish-brown tomentose, glabrescent; elliptic, ovate or obovate, 12.5–30 × 5–12 cm (leaves of saplings much larger up to 87 × 30 cm), base cuneate, *margin undulate*, apex acute or obtuse; midrib shallowly impressed above, prominently raised below; *lateral veins* 8–18(–30) pairs, ascending at an angle of 50–80° from midrib, *straight*, *arching and joining to form vein-loops near leaf margin*, raised on both sides; *intercostal venation distinctly scalariform*, reticulate near leaf margin, slightly distinct on both sides; petiole 3–7 cm long, shallowly grooved on adaxial side, glabrous. **Inflorescences** *fascicled along leafless* or *nearly leafless axillary shoots to 12 cm long*. **Flowers** whitish green; pedicel filiform, 2–9 mm long, reddish-brown sericeous, glabrescent; sepals ovate to obovate, 1–1.5 × 1–2 mm, sparsely sericeous outside, glabrous inside; corolla lobes spathulate to obovate, 1.5–2.5 × 1.5–2 mm; stamens 1.5–2.5 mm long, filaments subulate, 1–1.5 mm long, anthers ovoid, 0.5–1 mm across; staminodes subulate, 0.5–1 mm long; ovary conoid, 1–2 × 1 mm, 5-loculed, densely hirsute at base, style 5-ribbed, apex hirsute. **Fruits** *obliquely fusiform* and 1-seeded, or *obovoid-globose* and 2–5-seeded, 3.5 × 1.5–2.5 cm, rusty-brown tomentose. **Seeds** 1–5, oblong-obovoid, 1–2 × 0.6–1.2 cm; scar as long as seed, 4–5 mm broad; endosperm copious; cotyledons foliaceous.

Distribution. Sumatra, Christmas Island, Java, Borneo, the Philippines, Sulawesi, Lesser Sunda Islands, Maluku and Papua New Guinea. In Sabah, recorded from Beaufort (e.g., *SAN 44544*) and Ranau districts (e.g., *SAN 28290* and *SFN 27210*). Also occurs in Kalimantan (e.g., *bb. 19075* and *Kostermans 5865*).

Ecology. In lowland mixed dipterocarp to lower montane forest, at altitudes to 1400 m.

2. **Pouteria firma** (Miq.) Baehni Fig. 27.

(Latin, *firmus* = stiff; probably referring to the texture of the leaf)

Candollea 9 (1942) 284; Pennington *l.c.* 198; PROSEA *l.c.* 368; Turner, Gard. Bull. Sing. 47 (1995) 467; Coode *et al.* (eds.) *l.c.* 308. **Basionym:** *Chrysophyllum firmum* Miq., Fl. Ind. Bat., Suppl. (1861) 579. **Type:** *Teijsmann s.n.*, Sumatra, Bangka, Plangas (holotype BO). **Synonyms:** *Sideroxylon firmum* (Miq.) Pierre *ex* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 17, King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 164, Ridley, FMP 2 (1923) 260; *Beccariella firma* (Miq.) Pierre *l.c.* (1890) 30; *Planchonella firma* (Miq) Dubard, Ann. Mus. Colon. Marseille 20 (1912) 59, Masamune, PEB (1942) 600, P. Royen *l.c.* (1957) 316, Ng *l.c.* 434, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 24 m tall; buttresses to 1.5 m tall or absent. **Bark** smooth to slightly fissured, greyish brown; inner bark soft, reddish brown. **Twigs** terete, 3–10 mm diameter, yellowish to rusty-brown sericeous, glabrescent. **Leaves** *well-spaced along twigs*, thickly coriaceous, initially yellowish or reddish-brown villose on both surfaces, ultimately becoming glabrous above except on midrib, *not glaucous below*, bullate; elliptic-oblong to obovate-oblong, 8–14 × 4–6 cm, base cuneate to rounded and shortly decurrent, *margin undulate* and *recurved*, apex acuminate; midrib impressed to flat above, prominently raised below; *lateral veins 14–19 pairs*, *closely spaced*, ascending at an angle of 40–70° from midrib, *straight and parallel*, *arching and diminishing only near leaf margin*, slightly impressed above, prominent below; *intercostal venation densely scalariform*, faint above, distinct below; *petiole* (0.8–)2–4.5(–6.2) cm long, *broadly but shallowly grooved on adaxial side*, yellowish or rusty-brown velutinous, glabrescent. **Inflorescences** *2–5-flowered*, axillary or in axils of leaf scars. **Flowers:** pedicel angular, 5–6 mm long; sepals triangular to broadly ovate, 2–4.5 × 2–3 mm, thick and fleshy, apex acute, minutely hairy on both sides; corolla lobes oblanceolate, *c.* 2.5 × 1–1.5 mm, membranaceous, glabrous; stamens 2–3 mm long, filaments subulate, *c.* 1 mm long, anthers ovoid, *c.* 1.5 × 1 mm; staminodes filiform or spathulate, 1–1.5 mm long, rarely absent; ovary globose, 1–2 mm diameter, 5-loculed, rusty-brown sericeous, style 1–1.5 mm long, sparsely hairy; stigma obliquely lobed. **Fruits** obovoid to ellipsoid, *0.8–2.5 × 0.3–1.6 cm*, ripening black, *glabrous except at base*. **Seeds** 1–4, compressed ellipsoid, 0.6–2.3 × 0.3–0.6 cm; *scar linear*; endosperm copious; cotyledons foliaceous.

Vernacular name. Sarawak—*perluak* (Kelabit).

Distribution. Throughout Malesia and the Solomon Islands. In Borneo, scattered throughout Sabah (e.g., *SAN 21021* and *SAN 37840*) and Sarawak (e.g., *S 25839*, *S 34430* and *S 35949*). Also occurs in Kalimantan.

Ecology. In hill mixed dipterocarp to lower montane forest, at 850–1700 m altitudes.

Uses. The timber is used for making furniture, flooring, joinery, plywood and hardboard.

3. **Pouteria glabra** (Ridl.) I.M.Turner

(Latin, *glaber* = devoid of indumentum; the leaf and fruit)

Gard. Bull. Sing. 47 (1995) 467; Teo *l.c.* 215. **Basionym:** *Sideroxylon glabrum* Ridl., J. Roy. As. Soc. Str. Br. (1912) 476, *l.c.* (1923) 259. **Type:** *Ridley 15770*, Peninsular Malaysia, Selangor, Sepang Mines (holotype SING; isotype K). **Synonym:** *Planchonella glabra* (Ridl.) H.J.Lam *l.c.* (1925) 217, Ng *l.c.* 435.

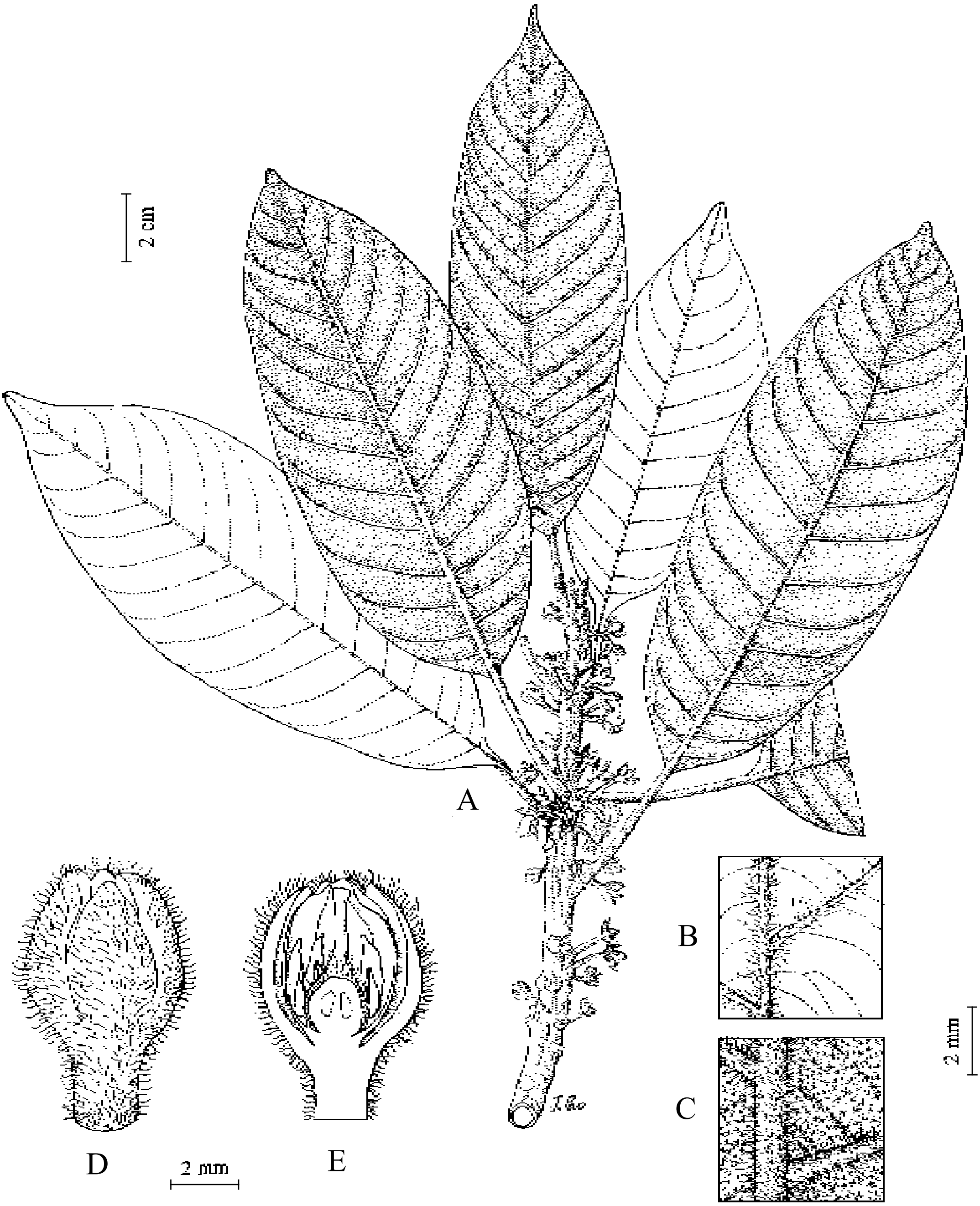

Fig. 27. *Pouteria firma*. A, flowering leafy twig; B, venation on lower leaf surface; C, indumentum of lower leaf surface; D, flower bud; E, longitudinal section of flower bud. (All from *Nooteboom 2122*.)

Tree to 15 m tall, 20 cm diameter. **Twigs** smooth, terete or angular, *c.* 4 mm diameter, initially tomentose, glabrescent. **Leaves** *well-spaced along twigs*, coriaceous, *glabrous on both surfaces*, drying yellowish brown, *not shining above*; *obovate* to *obovate-elliptic*, (8–)10–15(–22) × (3.5–)5–7.5(–10) cm, base narrowly cuneate, *margin not undulate*, recurved, *apex broadly acute* to *shortly acuminate*; midrib flat or raised above, prominently raised below; *lateral veins* 6–12 pairs, ascending at an angle of 50–80° from midrib, *straight*, *strongly arching and joining to form intramarginal vein-loops near leaf margin*, slightly raised above, prominently raised below; *intercostal venation laxly reticulate*, *without any vein descending from leaf margin and parallel to lateral veins*, faintly visible on both sides; *petiole 1.5–2 cm long*, flat on adaxial side, initially tomentose, glabrescent. **Inflorescences** axillary or in axils of leaf scars, 1–8-flowered. **Flowers** *c.* 3.5 × 3 mm; pedicel to 5 mm long; *sepals obovate*, *c.* 3 × 2 mm, ciliate, glabrous inside, minutely hairy outside, apex rounded; *corolla lobes c.* 2 × 1.5 mm, *thick and fleshy*, *membranaceous around margin*, glabrous; stamens 2.5–3.5 mm long, filaments *c.* 2 mm long, anthers *c.* 1 mm long; ovary globose, 1–1.5 mm diameter, style 1–1.5 mm long, glabrous, stigma 5-lobed; staminodes 5, slightly longer than stamens. **Fruits** *ovoid-globose* to *ellipsoid-globose*, *3–3.5 × 2–2.5 cm*, smooth, *glabrous*; *pericarp membranaceous*. **Seeds** obliquely fusiform 0.8–1.2 × 0.2–0.4 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Bt. Sarang, Tatau, Bintulu district (*S 20959*), G. Api, Baram district (*S 4279*) and Sebuaran, Bau district (*Jacobs 5479*) in Sarawak.

Ecology. Uncommon and localised on slopes and summits of limestone hills.

4. **Pouteria linggensis** (Burck) Baehni Fig. 28.

(of Lingga Is., Sumatra)

Boissiera 11 (1965) 57; Pennington *l.c.* 199; PROSEA *l.c.* 369; Turner *l.c.* 468. **Basionym:** *Sideroxylon linggense* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 15; Merrill, EB (1921) 482. **Type:** *Teijsmann s.n.* (1899), Sumatra, Lingga Is., Bt. Besar (holotype BO; isotype L). **Synonyms:** *Planchonella linggense* (Burck) Pierre, Not. Bot. Sapot. (1890) 35, P. Royen *l.c.* (1957) 384, Ng *l.c.* 436, Backer & Bakhuizen *f. l.c.* 189, Whitmore, Tantra & Sutisna *l.c.* 328; *Lucuma ?discolor* Baill., Bull Soc. Linn., Paris 2 (1891) 935; *Pouteria discolor* (Baill.) Baehni *l.c.* (1942) 337; *Sideroxylon pittosporifolium* Elmer, Leafl. Philip. Bot. 3 (1910) 872; *S. littorale* Ridl. *l.c.* (1923) 259; *Planchonella littoralis* (Ridl.) H.J.Lam *l.c.* (1925) 216; *Chrysophyllum curtisii* King & Gamble *l.c.* 159.

Tree to 12 m tall, 20 cm diameter. **Bark** greyish, smooth; inner bark yellowish. **Twigs** smooth, terete, 2–4 mm diameter, initially tomentose, glabrescent. **Leaves** *well-spaced along twigs*, chartaceous, minutely hairy below, glabrescent, often drying greyish green above and yellowish brown below; *lanceolate* to *narrowly elliptic*, (4–)6–10(–16) × (1.5–) 2.5–4(–5) cm, base cuneate, *margin undulate*, *slightly recurved*, apex broadly acute or acuminate; midrib flat to shallowly impressed above, raised below; *lateral veins* 9–10 pairs, ascending at an angle of 50–60° from midrib, *straight*, *arching and joining to form vein-loops near leaf margin*, faintly visible on both sides; *intercostal venation laxly reticulate*, with a few veins descending from leaf margin and parallel to lateral veins, obscure on both sides; *petiole 0.4–1.2 cm long*. **Inflorescences** axillary, 1–5-flowered. **Flowers** greenish yellow; pedicel *c.* 2.5 mm long, minutely hairy; sepals ovate, *c.* 2.5 × 2 mm, thick, minutely hairy outside and glabrous inside, margin membranaceous and ciliate; corolla lobes oblanceolate, 1.5 × 0.5–1 mm, membranaceous, glabrous; stamens included,

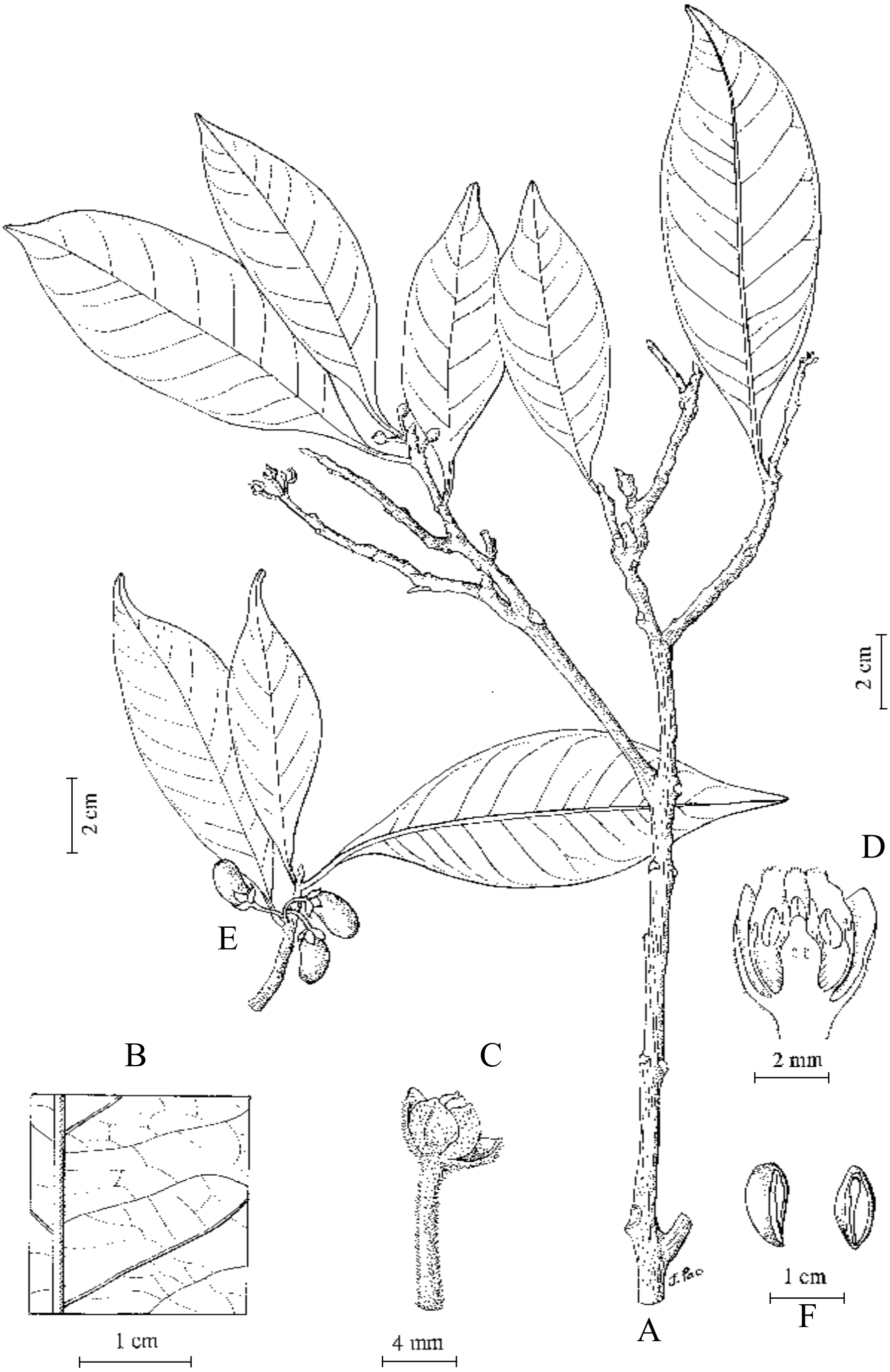

Fig. 28. *Pouteria linggensis*. A, flowering leafy twig; B, detailed venation of leaf; C, flower bud; D, longitudinal section of flower bud; E, fruiting leafy twig; F, seeds. (A–D from *SAN 42022*, E–F from *SAN 23860.*)

c. 1.5 mm long, filaments *c.* 1 mm long, anthers 0.8–1 mm long; staminodes 5; ovary globose, 1–1.5 mm diameter, style *c.* 0.5 mm long, stigma 5-lobed. **Fruits** ovoid-globose to obovoid, 1–2 × 0.5–1.3 cm, rounded-angular, *with a ring of hirsute hairs at base*, ripening purplish; *pericarp fleshy* to *slightly woody.* **Seeds** 1–5, obovoid, 0.7–1.5 × 0.4–0.6 cm, endosperm; scar linear; endosperm thick; cotyledons foliaceous.

Distribution. Sumatra (Lingga Is.), Peninsular Malaysia, Singapore, Borneo, the Philippines, Sulawesi, Papua New Guinea, N Australia, and the Pacific Islands. In Borneo, uncommon, recorded from Gaya (e.g., *SAN 42022*) and Sepanggar islands (e.g., *SAN 23860*) in Sabah, and from Bintulu (e.g., *S 24644*), Baram (e.g., *Hose 567*) and Datu Protected Forest (e.g., *S 41932*) in Sarawak. Also occurs in Brunei (e.g., *BRUN 3279*) and Kalimantan.

Ecology. In coastal lowland mixed dipterocarp forest, at altitudes to 400 m.

Uses. Produces good quality, durable *nyatoh* timber, used for indoor construction, furniture and tool handles.

5. **Pouteria maclayana** (F.Muell.) Baehni

(N.N. Miklucho-Maclay, 1846–1888, Russian geographer and ethnologist)

Candollea 9 (1942) 307; White, J. Arn. Arb. 31 (1950) 109; Herrmann-Erlee & P. Royen *l.c.* 475; Pennington *l.c.* 199; Coode *et al.* (eds.) *l.c.* 308; Teo *l.c.* 217. **Basionym:** *Illipe maclayana* F.Muell., Descr. Not. Pap. Pl. (1885) 12. **Type:** *Miklucho-Maclay s.n.*, SE New Guinea, Western division, Oriomo R., Wuroi (holotype MEL; isotype P). **Synonyms:** *Bureavella maclayana* (F.Muell.) Pierre, Not. Bot. Sapot. (1890) 16; *Lucuma maclayana* (F.Muell.) H.J.Lam *l.c.* (1925) 221, *l.c.* (1927) 476.

Tree to 18 m tall, 25 cm diameter. **Bark** smooth, brown. **Twigs** angular and striate, *c.* 4 mm diameter, initially tomentose, glabrescent. **Leaves** *crowded near ends of twigs*, chartaceous, initially tomentose, ultimately glabrous, drying greyish green to blackish above, yellowish brown below; elliptic-obovate, (11–)16(–28) × (7–)9(–13) cm, base cuneate, margin plane, apex acuminate; midribs flat or sunken above, prominently raised below; lateral veins 10–17 pairs, ascending at an angle of 70–80° from midrib, strongly arching and joining into intramarginal loops, prominent on both sides; intercostal venation reticulate, obscure on both sides; petiole 0.7–1.5 cm long, terete, initially tomentose, ultimately glabrous. **Inflorescences** axillary, to 6-flowered. **Flowers:** pedicel 2–3 mm long, glabrescent; sepals suborbicular, *c.* 2 mm across, minutely hairy outside, glabrous inside; corolla lobes lanceolate, *c.* 3 × 1 mm, glabrous; stamens included, filaments very short, anthers subglobose; staminodes short, subulate; ovary conoid, style short. **Fruits** obovoid to depressed globose, 0.8–1 × 1–1.3 cm, glabrous. **Seeds** 3, obovoid *c.* 5.5 × 3 cm; scar ovate.

Distribution. Sumatra (Lingga Is.), Talaud, Borneo, Maluku, Papua New Guinea and Solomon Islands. In Borneo, uncommon, only known by 5 collections from the eastern shoulder of Mt. Kinabalu (*RSNB 204*), Mt. Kinabalu Park (*Stevens et al. 224* and *Stevens et al. 654*) in Sabah, and from Jebong Limestone hill near Bau (*S 37396*), and Sampadai Hill, Melinau, Kapit district (*S 40737*) in Sarawak.

Ecology. In hill mixed dipterocarp forest on clay soils, limestone forest, and lower montane forest, at altitudes to 1500 m.

6. **Pouteria maingayi** (C.B.Clarke) Baehni

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Candollea 9 (1942) 343; Pennington *l.c.* 199; PROSEA *l.c.* 370; Turner *l.c.* 468. **Basionym:** *Sideroxylon maingayi* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 536; Ridley *l.c.* (1923) 258; King & Gamble *l.c.* 161. **Type:** *Maingay 993*, Peninsular Malaysia, Malacca, Sg. Udang (holotype K). **Synonyms:** *Sideroxylon borneense* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 15; *Lucuma maingayi* (C.B.Clarke) Dubard, Ann. Mus. Colon. Marseille, 20 (1912) 19, H.J. Lam *l.c.* (1925) 230, Masamune *l.c.* 589; *Planchonella maingayi* (C.B.Clarke) P.Royen *l.c.* (1957) 413, Ng *l.c.* 436, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 40 m tall, 80 cm diameter; bole columnar, with prominent symmetrical or steep plank-buttresses. **Bark** yellowish grey, smooth to shallowly fissured; inner bark granular, mottled yellow or white. **Sapwood** pale yellow. **Twigs** terete, 2.4–4 mm diameter, initially brownish tomentose, glabrescent. **Leaves** *well-spaced along twigs*, coriaceous, rusty-brown sericeous on both surfaces, ultimately glabrous and shining above, *not glaucous below*; obovate to obovate-elliptic or oblong, 7–25 × 3–7 cm, base cuneate and decurrent, *margin not undulate*, *plane*, apex acuminate with an obtuse tip, acumen 2–12 mm long; midrib flat or slightly impressed above, prominent below; *lateral veins 5–7(–11) pairs*, *well-spaced*, *subparallel*, ascending at an angle of 50–60° from midrib, *arching and diminishing toward leaf margin*; *intercostal venation laxly scalariform*, obscure on both sides; *petiole* 1.5–3.0 cm long, *flat on adaxial side*, angular below, rusty-brown pubescent, glabrescent. **Inflorescences** axillary, *to 15-flowered*. **Flowers** whitish; pedicel angular, 2–4 mm long, pubescent; sepals broadly ovate to orbicular, often unequal, 1.5–2.5 mm across, apex obtuse; corolla lobes suborbicular, *c.* 1 mm across, apex truncate; stamens *c.* 2 mm long, filaments *c.* 1.5 mm long, anthers *c.* 0.5 mm long, ovoid, laterally dehiscent; staminodes lanceolate, *c.* 1 mm long, apex subulate; ovary ovoid, *c.* 1 mm across, apex truncate, 5-loculed, densely pubescent, style cylindrical, *c.* 1 mm long, stigma 5-lobed. **Fruits** ellipsoid-globose, *2.5–4 × 2–3.5 cm*; pericarp thick, *sparsely rusty-brown tomentose.* **Seeds** 5, laterally compressed, ovoid, *c.* 1.5 × 0.8 cm, obtuse or subacute at both ends; *scar linear*; endosperm thick; cotyledons foliaceous.

Vernacular name. Sarawak—*nyatoh* (Iban, Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Uncommon in Sabah (e.g., *Clemens 51202*, *Clemens 56300* and *SAN 33794*) and Sarawak (e.g., *S 0025*, *S 3205*, *S 8049*, and *Haviland 2799/2321*). Also occurs in Kalimantan (e.g., *Winkler 2410*).

Ecology. In lowland mixed dipterocarp forest.

7. **Pouteria malaccensis** (C.B.Clarke) Baehni

(of Malacca, Peninsular Malaysia)

Candollea 9 (1942) 302; Hermann-Erlee & P. Royen *l.c.* 463; Ng *l.c.* 438; Anderson *l.c.* 320; Whitmore, Tantra & Sutisna *l.c.* 328; Pennington *l.c.* 199; PROSEA *l.c.* 371; Turner *l.c.* 468. **Basionym:** *Sideroxylon malaccense* C.B.Clarke *in* Hooker *f. l.c.* (1882) 537, King & Gamble *l.c.* 161, Gamble, Kew Bull. (1907) 109, Ridley *l.c.* (1923) 258. **Type:** *Maingay 994*, Peninsular Malaysia, Malacca (holotype SING; isotypes L, P).

Synonyms: *Fontbrunea malaccensis* (C.B.Clarke) Pierre *l.c.* (1890) 32; *Lucuma malaccensis* (C.B.Clarke) Dubard *l.c.* (1912) 19, Masamune *l.c.* 590; *Xantolis malaccensis* (C.B.Clarke) Baehni *l.c.* (1965) 23.

Tree to 30 m tall, 70 cm diameter; buttresses to 2.5 m tall. **Bark** greyish brown, smooth becoming shallowly fissured; inner bark pale brown. **Sapwood** pale yellow. **Twigs** smooth, terete, 4–8 mm diameter, densely appressed rusty-brown tomentose at tips. **Leaves** *well-spaced along twigs*, coriaceous, initially densely appressed rusty-brown tomentose on both surfaces, soon becoming glabrous except on midrib and occasionally on lateral veins, *glaucous below*; broadly obovate, oblanceolate to elliptic-oblong, (8–)10–18(–23) × (4–)7–9(–11) cm, base cuneate, margin revolute, apex obtuse to rounded; midrib flat to slightly raised above, prominently raised below; *lateral veins* (6–)9–14(–18) pairs, ascending at an angle of 50–65° from midrib, straight or curved, *arching and diminishing and becoming inconspicuous near leaf margin*, impressed above, prominent below; intercostal venation scalariform, distinct below; petiole (1.8–)3–4(–5.5) cm long, shallowly grooved on adaxial side, densely appressed rusty-brown tomentose. **Inflorescences** axillary, 5–11-flowered. **Flowers** greenish white, sweet-scented; pedicel 4–6 mm long, pubescent; sepals 3–4 × 2.5–4.5 mm, base connate, apex rounded, rusty-brown sericeous outside, glabrous inside; corolla lobes ovate, *c.* 4 × 3.5 mm, apex obtuse; stamens *c.* 1.5 mm long, filaments subulate, *c.* 1 mm long, anthers ovoid, *c.* 0.5 mm across; staminodes poorly developed or absent; ovary subglobose, *c.* 1 mm across, densely appressed rusty-brown tomentose, style cylindrical, *c.* 1 mm long, sparsely hairy, stigma minutely ribbed. **Fruits** ellipsoid-oblong to almost globose, 2.3–3.8 × 1.8–2.8 cm, smooth, topped by persistent style, *densely rusty-brown appressed tomentose*. **Seeds** 2–5, ovoid, 2–2.5 × 1 × 0.8–1 cm; *scar oblong*, plane, subconvex, to flat and keeled; cotyledons thick; endosperm absent.

Vernacular names. Sarawak—*nyatoh batu*, *nyatoh putih*, *nyatoh sulit* (Iban), *perdulan* (Kelabit), *sundip* (Malay); Brunei—*nyatoh batu* (Malay).

Distribution. Thailand, Sumatra (Riau Archipelago, Lingga Is.), Peninsular Malaysia, Borneo, and Sulawesi. In Sabah, recorded from Ranau district (e.g., *SAN 49217*), and in Sarawak from Kelabit Highlands and Semengoh FR (e.g., *S 0154*, *S 3369*, *S 11052*, *S 32430*, and *S 47697*). Also occurs in Brunei and Kalimantan.

Ecology. Common in lowland and hill mixed dipterocarp on leached yellow sandy and clay soils to lower montane forest, at altitudes to 1400 m.

Uses. The timber is used by local people for making furniture.

8. **Pouteria mindanaensis** (H.J.Lam) Baehni Fig. 29.

(of Mindanao, the Philippines)

Candollea 9 (1942) 326; Teo *l.c.* 217. **Basionym:** *Planchonella mindanaensis* H.J.Lam *l.c.* (1925) 207, *l.c.* (1927) 473, P. Royen *l.c.* (1957) 414. **Type:** *Clemens 1126*, the Philippines, Mindanao (holotype PNH†?; isotypes BO, G, K, L). **Synonym:** *Xantolis mindanaensis* (H.J.Lam) Baehni *l.c.* (1965) 23.

Tree to 16 m tall, 25 cm diameter. **Twigs** stout, terete to angular, to 10 mm diameter, appressed yellowish-hairy at tips, glabrescent. **Leaves** *well-spaced along twigs*, *thickly coriaceous*, initially

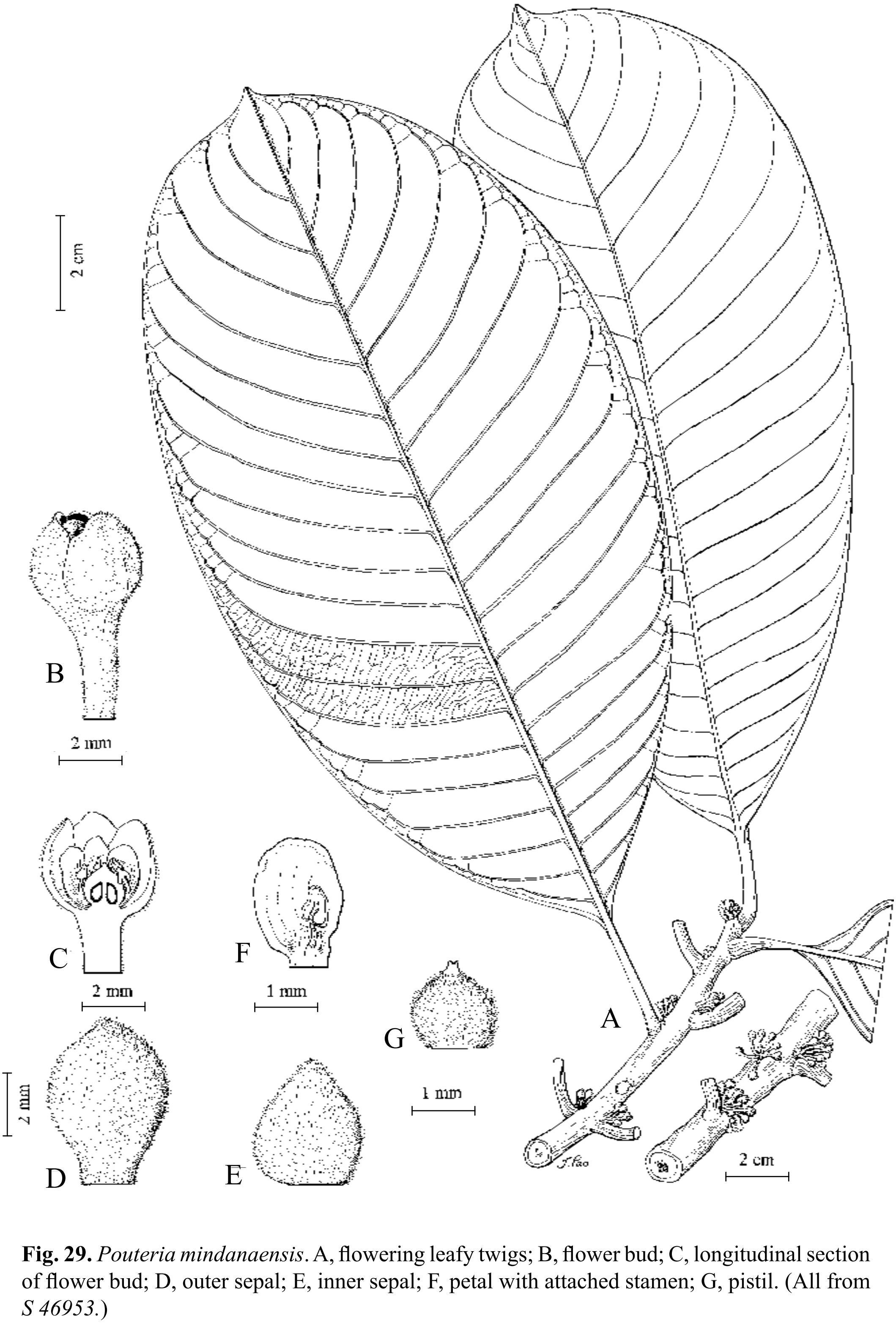

Fig. 29. *Pouteria mindanaensis*. A, flowering leafy twigs; B, flower bud; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petal with attached stamen; G, pistil. (All from *S 46953*.)

pale yellow appressed-pubescent on both surfaces, ultimately glabrous, *drying yellowish brown*, *not shining above*; obovate to oblong, 7–38 × 3.5–21 cm, base attenuate, decurrent, *margin not undulate*, apex broadly acuminate to acute; midrib flat to slightly impressed above, prominently raised below; *lateral veins* 13–21 pairs, ascending at an angle of 50–70° from midrib, *straight*, *arching and joining to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation scalariform*, sometimes laxly reticulate near leaf margin, obscure on both sides; petiole 2–5 cm long, flat on adaxial side, initially tomentose, glabrescent. **Inflorescence** *axillary*, 8–15-flowered. **Flowers** unisexual or bisexual; pedicel 5–12 mm long, appressed yellowish-pubescent; sepals broadly ovate or orbicular, 2.5–5 × 2–4 mm, ciliate, appressed yellowish-sericeous outside, glabrous inside; corolla glabrous, lobes suborbicular, 1–2 mm across; stamens *c.* 2 mm long, filaments *c.* 1 mm long, anthers ovoid, *c.* 1 mm long, laterally dehiscent; staminodes lanceolate, about half as long as corolla lobes; ovary conoid, 0.5–1 mm long, 5-loculed, pubescent, style stout. **Fruits** *ovoid*, 1–2 × 0.8–1.5 cm; pericarp membranaceous, smooth, glabrous. **Seeds** 1–4, laterally compressed, ellipsoid, *c.* 1.5 × 0.6 cm, obtuse at both ends; scars linear, *c.* 15 × 1.5 mm; endosperm copious; *cotyledons foliaceous*.

Distribution. Borneo and the Philippines. In Sarawak, recorded by a single collection (*S 46953*) from Lundu district. Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitude about 150 m.

9. **Pouteria obovata** (R.Br.) Baehni Fig. 30.

(Latin, *ob* = inverted, *ovatus* = egg-shaped; the leaf shape)

Candollea 9 (1942) 324; Pennington *l.c.* 199; PROSEA *l.c.* 371; Turner *l.c.* 468; Coode *et al.* (eds.) *l.c.* 308; Argent *et al.* (eds.) *l.c.* 590. **Basionym:** *Sersalisia obovata* R.Br., Prodr. (1810) 530. **Type:** *Banks s.n.*, Australia (holotype K). **Synonyms:** *Achras obovata* (R.Br.) Benth. & F.Muell., Fl. Austr. 4 (1869) 283; *Planchonella obovata* (R.Br.) Pierre, Not. Bot. Sapot. (1890) 36, H.J. Lam *l.c.* (1925) 202, *l.c.* (1927) 473, Masamune *l.c.* 600, P. Royen *l.c.* (1957) 368, Ng *l.c.* 437, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 20 m tall, 35 cm diameter; bole straight with irregular, conical or round coppery brown crown. **Bark** greenish to reddish brown, with grey mottles, shallowly fissured; inner bark reddish. **Sapwood** yellow. **Twigs** terete, 4–6 mm diameter, densely appressed reddish-brown tomentose, glabrescent. **Leaves** *well-spaced along twigs*, chartaceous to thinly coriaceous, *glabrous and shining above*, *densely reddish-brown appressed-tomentose below*, *late-glabrescent*; *obovate*, *obovate-elliptic* or *obovate-oblong*, (6–)10–12(–17) × (2.5–)5–7(–9) cm, base narrowly to broadly cuneate, *margin not undulate*, recurved, *apex rounded*; midrib and lateral veins slightly raised on both sides; *lateral veins* (5–)9(–11) pairs, ascending at an angle of 40–60° from midrib, *straight*, *arching and joining to form vein-loops near leaf margin*, faintly visible on both sides; *intercostal venation densely reticulate*, *with a few veins descending from leaf margin and parallel to lateral veins*, obscure on both sides; *petiole 1.5–2.5 cm long*, shallowly grooved on adaxial side, minutely tomentose, glabrescent. **Inflorescences** axillary or in axils of leaf scars, 1–20-flowered. **Flowers** greenish white; pedicel stout, 2.5–6 mm long; *sepals broadly ovate* to *suborbicular*, 1.5–2 mm across, apex rounded, ciliate, tomentose outside, glabrous inside; *corolla lobes* broadly ovate to oblong, 1.5–2 × 1.5–2.5 mm, *membranaceous throughout*; stamens 2.5–3.5 mm long, filaments filiform, 2–3 mm long, anthers ovoid or oblong, 0.5–1 mm long; staminodes 1–1.5 mm long, lanceolate or deltoid; ovary conoid or obovoid, 1 × 1.5–2 mm, truncate at apex, style stout,

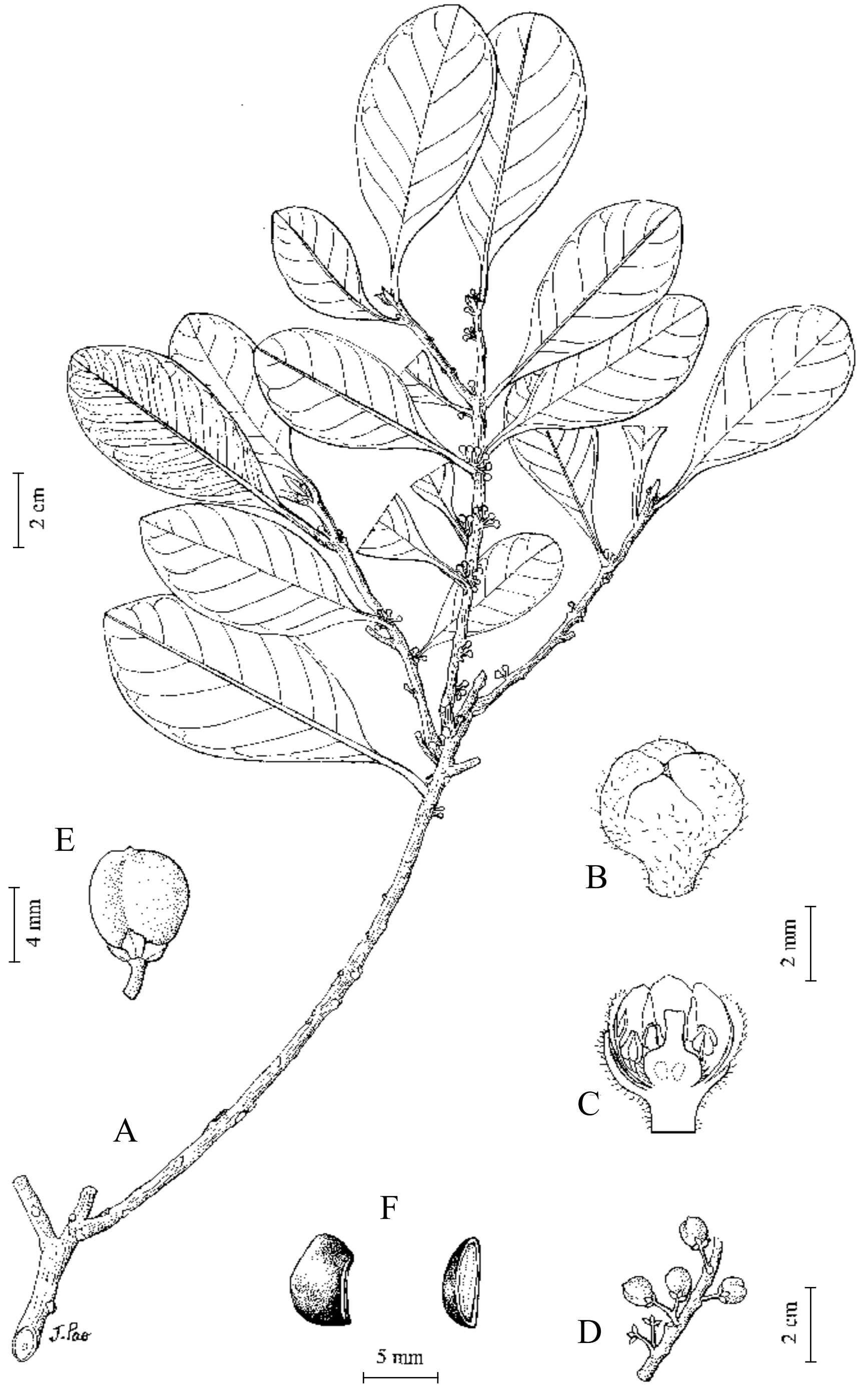

Fig. 30. *Pouteria obovata*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, infructescences; E, fruit; F, seeds. (A–C from *S 36619*, D–F from *S 37143*.)

glabrous, 5-ribbed, *c.* 0.5 mm long, stigmas capitate, 5-lobed. **Fruits** *obovoid* or *subglobose*, broadly 2–5-ribbed, *1–1.5 cm across*, *glabrous*; *pericarp membranaceous*, pale yellow, turning reddish brown upon ripening. **Seeds** 1–5, obliquely fusiform, 0.8–1.2 × 0.2–0.4 cm, obtuse to subacute at both ends; endosperm thick; cotyledons foliaceous.

Vernacular names. Sabah—*pelawan-pelawan* (Merantaman, Sipitang). Sarawak—*gumbirar merah* (around Jeidong), *nyatoh laut* (Malay).

Distribution. Seychelles Islands, India, Pakistan, S China, Taiwan, Vietnam, Cambodia, Myanmar, Thailand, Malesia, Solomon Islands, NE Australia and S America. Common and scattered throughout Sabah (e.g., *SAN 20623*, *SAN 27141*, *SAN 78138*, *SAN 94419*, and *SAN 107871*) and Sarawak (e.g., *S 7677*, *S 10206*, *S 25576*, *S 38554*, and *S 62204*). Also occurs in Brunei (e.g., *BRUN 5066*, *Coode 6474* and *van Niel 3862*) and Kalimantan (e.g., *bb. 34572*).

Ecology. Frequent in rocky and sandy littoral fringe vegetation, occasional in lowland *kerangas*, limestone hill, and estuarine mangrove swamp forests.

Uses. The timber is suitable for carving and cabinet making, and occasionally also used for making various types of domestic utensils. A decoction of leaves is used to relieve stomach ache; poultice from crushed leaves is used to treat lumbago.

Incompletely known species

Pouteria sp. 1

Tree 25 m tall, 60 cm diameter. **Twigs** smooth, terete, 4–5 mm diameter; young parts covered with rusty-brown indumentum, soon becoming glabrous. **Leaves** coriaceous, drying brownish on both sides, glabrous above, initially rusty-brown pubescent below, soon becoming glabrous except midrib; lanceolate, 7.5–9.5 × 2–2.5 cm, base cuneate, margin wavy, apex acute; midrib and lateral veins raised on both surfaces; lateral veins 11–14 pairs, ascending at an angle of 45–50° from midrib, straight, arching and joining into intramarginal loops near leaf margin; intercostal venation scalariform-reticulate, obscure on both sides; petiole 2–2.5 cm long, minutely hairy, shallowly grooved on adaxial side. **Inflorescences** axillary, fascicles 1–7-flowered. **Flowers** greenish yellow; pedicel 1–1.5 cm long; sepals ovate, *c.* 5 × 3–4 mm, minutely hairy outside, glabrous inside; petals glabrous, membranaceous, *c.* 3 × 3.5 mm; stamens included, *c.* 2.5 mm long; staminodes *c.* 2.5 mm long; ovary conoid, *c.* 2 mm across, minutely hairy; style *c.* 2 mm long, glabrous, stigma 5-lobed. **Fruits** unknown.

Distribution. Only known by two collections (*SAN 92450* and *SAN 118204*) from Sandakan district, Sabah.

11. **SARCOSPERMA** Hook.*f.*

(Greek, *sarkos* = fleshy, *spermum* = seed)

A. Noorsiha

In Bentham & Hooker *f.*, Gen Pl. 2 (1876) 655; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 159; Ridley, FMP 2 (1923) 260; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 248, *ibid.* 3, 8 (1927) 18, FM 1, 4 (1948) 32; H.J. Lam & Varossieau, Blumea 3, 1 (1938) 185; H.J. Lam & P. Royen, Blumea 7, 1 (1952) 148; Ng, TFM 1 (1972) 440; Anderson, CLTS (1980) 320; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 329; Pennington, Gen. Sapot. (1991) 179. **Synonyms:** *Apoia* Merr., Philip. J. Sci. 17 (1920) 605; *Bracea* King, J. As. Soc. Beng. 64 (1895) 101.

Trees or shrubs. **Stipules** *present*, small, caducous. **Leaves** *opposite* or *subopposite*, rarely spirally arranged and well-spaced along twigs, *often with glandular pits near axils of lateral veins*; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation scalariform; *petiole often with a pair of stipels at distal end*. **Inflorescences** *racemose* or *paniculate*, axillary or in axils of leaf scars. **Flowers** bisexual; *sepals 4–5*, *in a single whorl*, imbricate; corolla funnel-shaped, tube short, lobes 5, imbricate in bud, tube shorter than lobes; stamens 5, in a single whorl, inserted at top of corolla tube, filaments short, anthers introsely or laterally dehiscent; staminodes 5, inserted at throat of corolla tube, alternating with stamens; disk (nectary) absent; ovary 1–2-loculed, glabrous, style short and stout, stigmas minutely 2–4-lobed, ovules 1 in each locule, anatropous or apotropous, placentation basal. **Fruits** 1–2-seeded; pericarp fleshy. **Seeds** ellipsoid to ovoid, not laterally compressed; scar small, circular, basal or basiventral; endosperm absent; cotyledons plano-convex, thick; endosperm absent.

Distribution. About 8 species, distributed from the eastern part of the Himalayas to Myanmar, S China, Indo-China and Malesia. Only one species occurs in Sabah and Sarawak.

Ecology. Scattered in different forest types from sea level to about 1300 m altitude.

Taxonomy. Lam (*l.c.* (1925) 248) placed the genus *Sarcosperma* in a family of its own, the Sarcospermaceae. Many authors (*e.g.* Bentham & Hooker *f. l.c.* 655; King & Gamble *l.c.*159; Ridley *l.c.* 260; Keng, OFMSP (1978) 231), however, included the genus in the Sapotaceae. Following Lam, Hutchinson (Fam. Fl. Pl. 1 (1964) 351), Ng (*l.c.* 440), Anderson (*l.c.* 320), Whitmore, Tantra & Sutisna (*l.c.* 329) and van Steenis (Checkl. Gen. Names in Mal. Bot. (1987) 112) maintained the separation of the Sarcospermaceae from the Sapotaceae by the following characters: opposite and stipulate leaves, racemose or paniculate inflorescence, petiole with stipels at the distal end, and by the presence of glandular pits in the axils of lateral veins on lower leaf surface. However, the recently published generic monograph of the Sapotaceae by Pennington (*l.c.* 179) clearly indicated that on account of morphological, palynological, cytological and phytochemical evidence, the genus *Sarcosperma* should be retained in the Sapotaceae, tribe *Sideroxyleae*, together with *Argania*, *Diploon*, *Neohemsleya*, *Nesoluma*, and *Sideroxylon.* Pennington's conclusion is adopted in this account.

Sarcosperma paniculatum (King) Stapf & King Fig. 31.

(Latin, *paniculatus* = having flowers arranged in a loosely branched inflorescence)

In Hooker *f.*, Icon Pl. 7 (1901) *t.* 2690; King & Gamble *l.c.* 160; Ridley *l.c.* 260; H.J. Lam *l.c.* (1925) 248, *l.c.* (1927) 21, *l.c.* (1948) 32; H.J. Lam & Varossieau *l.c.* 190; H.J. Lam & P. Royen *l.c.* 152; Ng *l.c.* 440; Anderson *l.c.* 320; Whitmore, Tantra & Sutisna *l.c.* 329; Pennington *l.c.* 180; Turner, Gard. Bull. Sing. 47 (1995) 468. **Basionym:** *Bracea paniculata* King, J. As. Soc. Beng. 64 (1895) 101. **Type:** *King's Collector 8086*, Peninsular Malaysia, Perak, Batang Padang (holotype K). **Synonyms:** *Discocalyx macrocarpa* Elmer, Leafl. Philip. Bot. 8 (1915) 2781; *Apoia macrocarpa* (Elmer) Merr. *l.c.* 605; *Sarcosperma breviracemosum* H.J.Lam *l.c.* (1927) 21.

Tree to 40 m tall, 70 cm diameter; bole usually columnar, with steep buttresses to 2.5 m tall. Crown spreading. **Bark** reddish brown, soft, shallowly fissured; inner bark pale yellow, soft, fibrous. **Sapwood** white to pale yellow. **Stipules** subulate, triangular, *c.* 4 mm long, caducous, scars triangular or linear. **Leaves** thinly coriaceous, glabrous, dark brown when dried; elliptic oblong, (6–)9–18(–28) × 3–10 cm, base acute to attenuate, margin plane to slightly wavy, apex acuminate; midrib slender, prominent beneath, sunken above; lateral veins 6–10 pairs, slender, about 2.5 cm apart, at an angle of 50–70° with midrib, arching and diminishing toward leaf margin, *often with small glandular pits near junctions with midrib*; intercostal venation finely reticulate, inconspicuous on both sides; petiole 1–2.5 cm long, glabrous to slightly tomentose, grooved on adaxial side, *stipels acute*, *0.5–2 mm long*. **Inflorescences** glabrous to sparsely tomentose, branched panicles of 10–15 cm long or unbranched and 1–2 cm long; bracts glabrous, acute, *c.* 1 mm long. **Flowers** fascicled or solitary along inflorescence branches, *c.* 5 mm across, yellow to pale greenish white; pedicel 1–1.5 mm long; sepals roundish or broadly ovate, *c.* 2 mm across; corolla tube *c.* 1 mm long, lobes ovate, *c.* 3 × 2 mm; stamens *c.* 1 mm long, filaments very short, anthers ovate; staminodes prominent, acute, *c.* 1 mm long; ovary conical, *c.* 2 × 1 mm, 2-loculed, glabrous, style *c.* 1 mm long, stigma 2-lobed. **Fruits** ovoid-globose, 1.7–2 × 1.5–1.7 cm, ripening red and purplish black, with persistent style and calyx, 1(–2)-seeded; stalk *c.* 0.3 cm long. **Seeds** globose, *c.* 1.5 cm across; testa thin, pale brown; scar round, *c.* 3 × 4 mm.

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, Lesser Sunda Islands, and New Guinea. In Sabah and Sarawak, uncommon and known only by 2 collections from Mt. Kinabalu in Sabah (*RSNB 103*) and Kelabit Highlands in Sarawak (*Nooteboom & Chai 2121*). Also occurs in E Kalimantan (e.g., *Kostermans 5810*).

Ecology. Scattered in secondary forest and other open habitats at altitudes ranging from 130 to 1300 m, on various soil types including andesite and limestone derived soils.

Uses. The wood is soft and not durable. No record of its use in Sabah and Sarawak but in Sumatra it is used as timber.

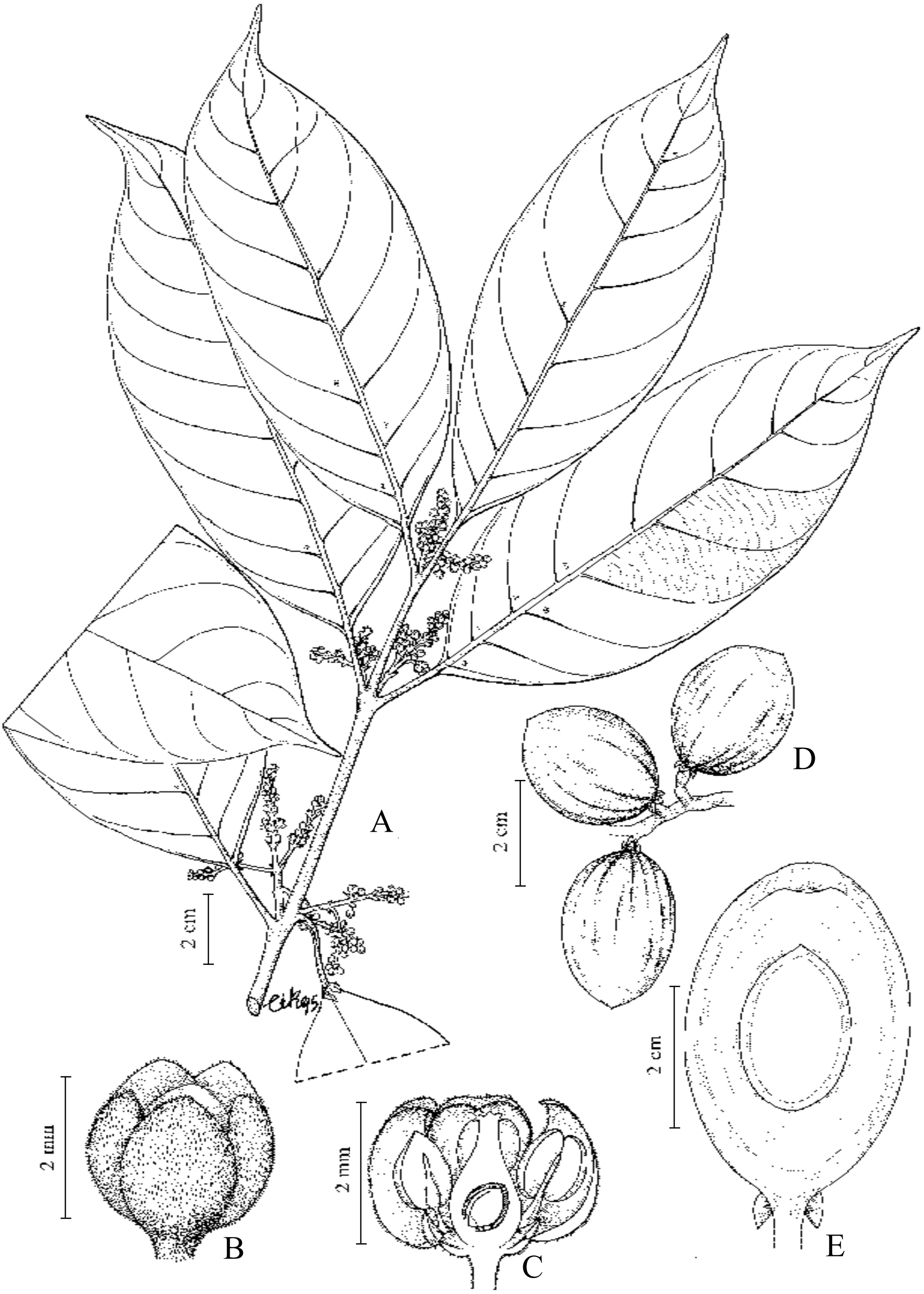

Fig. 31. *Sarcosperma paniculatum*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, infructescence; E, longitudinal section of fruit. (A–C from *Maradjo 142* (= *Meijer 5005*), D–E from *For. Dept. CF 875*.)

APPENDIX

New Taxa, Taxonomic Status and Combinations

OLEACEAE

Chionanthus balgooyiana Kiew, ***sp. nov.***

Chionanthi rugosae simulans, sed folio breviore ad apicem acute angustatum, petiolo longiore differt. ***Typus:*** *Martin S 38039, Borneo, Sarawak, G. Mulu* (*holotypus SAR; isotypi K, KEP, SAN*).

Notes. Specimens of this species were previously listed under *C. rugosus* (Kiew, Malay. For. 43, (1980) 389). *Chionanthus rugosus* is extremely rare and is known from just three collections, all from a single lowland locality (Semengoh FR in Sarawak). Among the Bornean *Chionanthus* species, these two taxa are distinct in their very slender twigs, small narrowly lanceolate leaves with a cuspidate apex, short, few-flowered racemes, and rugose fruit surface.

The new species is named in honour of Max van Balgooy who generously shares his extensive knowledge of the Malesian flora and who first drew my attention to the fact that specimens of more than one species were cited for *C. rugosus*. *Chionanthus balgooyiana* grows at higher altitudes in lower montane forest and is distinct from *C. rugosus* in having leaves that are narrowed in the upper half (i.e., are widest in the lower half), that dry greenish grey, have a midrib raised on the upper surface and lateral veins that are plane and obscure on both the upper and lower surfaces as compared with *C. rugosus* where leaves are widest at or above the middle, that dry chestnut-brown and the midrib and lateral veins are impressed on the upper surface and are prominent on the lower surface.

Specimens examined: BORNEO, SARAWAK—Second Division, Lingga, Bt. Senyandang, *Lee S 44254* (K, SAR); Fourth Division, Dulit Range, *Richards 1706* (K), *Richards 1773* (K), *Tong S 34896* (KEP, SAN), *Dayang Awa & Yii S 46777* (K); G. Mulu, *Martin S 38039* (K, KEP, SAN, SAR).

Chionanthus callophylloides Kiew, ***sp. nov.***

Chionantho callophyllo prima facie similissima, sed foliis angustioribus, inflorescentiis brevioribus. ***Typus:*** *Saikeh SAN 79917, Borneo, Sabah, Sandakan district, Sepilok FR* (*holotypus SAN; isotypus SING*).

Notes. Among the Bornean species, *Chionanthus callophylloides* most resembles *C. callophyllus* in its subcoriaceous leaves that dry pale grey-green, its thickened petioles that do not dry black, inflorescences with first order branching and fruits that dry with a white bloom. The new species is distinct from *C. callophyllus* in its narrow leaves with an acuminate apex (the leaves of *C. callophyllus* are distinctly obovate and are broader, 23–38 × 7–13 cm) and the fruit is finely ridged and has a narrowed base (*C. callophyllus* has a smooth fruit with a distinctly flattened base).

Specimens examined: BORNEO, SABAH—Sandakan district, Sepilok FR, *Saikeh SAN 79917* (SAN, SING), *Davies SAN 92435* (SAN, SING), Labuk Road, *Amir SAN 35605* (SAN, SING), Sg. Pamentarian, *Fidilis 120061* (SAN, SING); Lahad Datu district, *Chai SAN 25086* (SAN, SING); Ranau district, Kg. Nalumad, *Aban SAN 49386* (KEP, SAN); Pitas district, Sg. Kelang, *George & Amin SAN 121242* (SAN, SING); Sipitang district, Menggalong FR, *Saikeh SAN 72028* (SAN, SING), Lumaku FR, *Berhaman et al. SAN 132640* (KEP, SAN, SING). SARAWAK—Fourth Division, G. Mulu NP, Ulu Sg. Berar, *Chai S 39633* (SAR, SING).

Chionanthus globosus (Kiew) Kiew, ***stat. nov.***

Basionym: *Chionanthus elaeocarpus* (Stapf) Kiew var. *globosus* Kiew, Malay. For. 43 (1980) 374, *ibid.* 44 (1981) 150. **Type:** *Chai S 35338*, Borneo, Sarawak, Kelabit Highlands (holotype SAR; isotype K).

Notes. *Chionanthus globosus*, previously treated as a variety of *C. elaeocarpus* (Stapf) Kiew (= a synonym of *C. macrocarpus* Blume), is here raised to species level. While the flowers of *C. macrocarpus* and *C. globosus* are similar, these two taxa are distinct not only in fruit shape but also in constant differences in leaf characters. Although leaves of both species are obovate, those of *C. globosus* are much thicker, have longer petioles, the laminas are four to five times longer than the petiole, are smaller and are only twice as long as wide and have fewer pairs of lateral veins, and those of *C. macrocarpus* are less coriaceous, have a shorter petiole, the laminas are ten times longer than the petiole, are larger and three times longer than wide and have more pairs of lateral veins.

Specimens examined: BORNEO, SABAH—Sipitang district, G. Lumaku, *Wood SAN 16715* (K, KEP, SING), Ulu Menggalong, *Wood SAN 16745* (SING). SARAWAK—Belaga district, Bakun river, *Zainuddin et al. AZ 5616* (KEP); Simunjan district, Ulu Sg. Sabal Aping, *Ilias S 38588* (K); Kelabit Highlands, *Chai S 35338* (K, SAR); Marudi district, Baram, Ulu Tinjar, *Chai S 34818* (K, KEP, SAR); Lawas district, *Anderson S 26013* (K, SING), *Ilias S 26013* (SAR); Kapit district, *Ilias S 41049* (K); Limbang district, *Wright & Othman S 32225* (K, KEP, SAR, SING); Upper Pieran, *Pickles S 3592* (SING). KALIMANTAN—W Kutei, Mt Kemoel, *Endert 3134* (K), *Endert 3634* (K), *Endert 4308* (K), and *Endert 4436* (K).

Chionanthus kinabaluensis Kiew, ***sp. nov.***

A speciebus borneensibus ceteris in nervatura tertiaria infra conspicue reticulata differt. ***Typus:*** *Clemens 29348-30229* (*p.0189 Oleaceae*)*, Borneo, Sabah, G. Kinabalu, Tenompok* (*holotypus SING; isotypus SING*).

Notes. The label gives the number as between 29348 and 30229 and the date as April 20 1932 with a handwritten number “p.0189 Oleaceae”. There are two sheets at SING. One, chosen as the holotype, has immature unexpanded inflorescences with minute buds (field notes state that they are cream) and both have fruits. As yet, this species is known only from the type specimen. The leaves of this species are extremely distinctive in that the reticulation of the intercostal veins on the lower surface, although almost plane with the lamina surface, is conspicuous as the reticulation is darker than the lamina surface.

Chionanthus leopoldi Kiew, ***sp. nov.***

Chionantho pachyphylla in foliorum venis paucioribus, inflorescentiis ramis inferioribus brevioribus differt. ***Typus:*** *Leopold & Taha SAN 83546, Borneo, Sabah, Labuk Sugut district, Mile 87.5 Telupid Road* (*holotypus SAN; isotypi K, KEP, L, SAR, SING*).

Notes. *Chionanthus leopoldi* is closest to *C. pachyphyllus* in its large coriaceous leaves, inflorescence type and globose fruits. However, it is readily told apart by its lamina which has fewer lateral veins (7–8 pairs) that are plane with the upper surface (in *C. pachyphyllus* there are 8–14 pairs and they are deeply impressed above), by its more slender twigs (those of *C. pachyphyllus* are stout and have conspicuous horseshoe-shaped leaf scars), and by the shorter (1–1.25 cm long) lowest branch of the inflorescence (*c.* 3 cm long in *C. pachyphyllus*). Furthermore, *C. leopoldi* has been collected from lower altitudes than *C. pachyphyllus*, which is more widespread (Sabah, Sarawak and Kalimantan) and is recorded from hill and lower montane forest between 820–1350 m altitude. Much of the forest in Telupid area, such as Bt. Tingkar, is on ultramafic soil, but it is not known if this species is part of the ultramafic flora as herbarium labels do not record soil type. This distinctive species is named after Leopold Madani, who twice collected specimens of this species, in recognition of the invaluable assistance he has given many botanists in identifying plants from Sabah.

Specimens examined: BORNEO, SABAH—Labuk Sugut district, Telupid, *Leopold & Taha SAN 83544* (SAN), *Leopold & Taha SAN 83546* (K, KEP, L, SAN, SAR, SING), *Aban & Rahim SAN 93967* (K, L, SAN, SING), *Majawat et al. SAN 125946* (K, KEP, SAN, SING); Kinabatangan district, Tongod, Bt. Tingkar, *Leopold SAN 133958* (KEP, SAN, SING); Crocker Range, *Nordin SAN 85682* (KEP, SAN, SAR, SING).

Chionanthus plurifloroides Kiew, ***sp. nov.***

A Chionantho pluriflora inflorescentiis brevibus racemosis, fructibus laevibus globosis recedit. ***Typus:*** *Kulip & Goh SAN 137038, Borneo, Sabah, Kinabatangan district, Tongod, G. Tingkar Waterfall* (*holotypus SAN; isotypus KEP*).

Notes. The foliage of this new species is closely similar to that of *C. pluriflorus* in shape, size and in drying chestnut-brown with the veins darker on the lower surface. It is, however, clearly distinct from this species in the inflorescences and fruits, because *C. pluriflorus* has much branched panicles and its fruits are large and ellipsoid with a verrucose surface.

Specimens examined: BORNEO, SABAH—Sipitang district, Ulu Mendulong, *Wood 16828* (SING); Penampang district, Km 63 Kota Kinabalu-Tambunan Road, *Amin et al. SAN 66094* (SAN); Tawau district, St. Lucia, *Kadir A 2004* (SING); Sandakan district, *Elmer 20332* (BRIT, SING), *Taloon SAN 10788* (SING); Labuk Sugut district, Sapi FR, *Leopold & Kodoh SAN 81412* (SAN), Segalind Lokan FR, *Majawat SAN 124515* (SAN); Kinabatangan district, Tongod, G. Tingkar Waterfall, *Kulip & Goh SAN 137078* (KEP, SAN). SARAWAK—Sri Aman district, G.

Lesong, *Lee S 43242* (SAN, SAR). KALIMANTAN—E Kutei, G. Tepian Lobang, *Kostermans 5321* (SING).

Chionanthus polygamus (Roxb.) Kiew, ***comb. nov.***

Basionym: *Samara polygama* Roxb., Fl. Ind. 1 (1820) 435, *ibid.* 2nd. edition 1 (1932) 414. **Type:** *Roxburgh 2603*, Maluku (BM). **Synonyms:** *Ardisia polygama* (Roxb.) A.DC, Prod. 8 (1844) 138; *Linociera polygama* (Roxb.) S.Moore, J. Bot. (London) 51 (1913) 216; *Chionanthus laxiflorus* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 319. Type: *Korthals s.n.* (= *RHL Sheet No. 908158835*), Borneo, Kalimantan, Martapura (holotype L; isotype K), *syn. nov.*; *Linociera oxycarpa* Lingelsh., Bot. Jahrb. 61 (1927) 10. Lectotype: *Ledermann 9705*, New Guinea (L).

Notes. Moore (1913) located a Roxburgh specimen from the Moluccas at BM annotated by Roxburgh as *Samara polygama* (Myrsinaceae) and concluded that it in fact belonged to *Linociera* (Oleaceae), a genus now combined with *Chionanthus*, on account of it having opposite leaves and a cymose inflorescence. Roxburgh had described the flowers as having a tetramerous calyx and corolla and stamens with “filaments short, and inserted in a notch near the edge of the base of the petals”. Moore dissected one of the two remaining flowers to find four stamens and an “apparently rudimentary” ovary. Polygamy is very unusual among Malesian *Chionanthus*, only two species, *C. laxiflorus* and *C. macrobotrys*, being known. Examination of the type of *L. polygama* (which is now bereft of inflorescences and its two flowers) shows that it is the same as *C. laxiflorus* in its dark grey-green leaves with 12 pairs of veins and attenuated apex with a rounded tip. (It would not be mistaken for *C. macrobotrys,* which has thickly coriaceous leaves with recurved margins, fewer lateral veins and the apex is shortly acuminate). There is therefore no doubt that *C. laxiflorus* is the same as Roxburgh’s *Samara polygama*. *Chionanthus polygamus* has a wide geographic distribution and shows some variation between populations as regards the stamens. In Sumatra, some specimens have male flowers with four stamens, elsewhere they have two. In New Guinea, the species is effectively unisexual as the bisexual flowers produce staminodes (the anther sacs do not develop). In Borneo, the male flowers and bisexual flowers have two stamens but those of the bisexual flower are smaller. After *C. ramiflorus*, *C. polygamus* is the most common species in Malesia and occurs in Sumatra, Peninsular Malaysia, Borneo, Sulawesi, Maluku and New Guinea.

Chionanthus sabahensis Kiew, ***sp. nov.***

A Chionantho pluriflora in foliis angustioribus, fructibus laevibus globosis recedit. ***Typus:*** *Carr SFN 27170, Borneo, Sabah, G. Kinabalu, Ulu Kinunut* (*holotypus SING*).

Notes. Leaves of *C. sabahensis* rather resemble those of *C. pluriflorus* in their length, texture and in drying brown but they are different in that they are more than three times longer than wide (about twice as long as wide in *C. pluriflorus*) and the lateral veins drying concolorous with the leaf blade on the lower surface (in *C. pluriflorus* they are darker brown). In addition, the inflorescence has only first order branching compared with second order branching in *C. pluriflorus*, and the globose, smooth fruits with short stalks are very different from the ellipsoid, verrucose fruits with stalks *c.* 7 mm long of *C. pluriflorus*.

Specimens examined: BORNEO, SABAH, Crocker Range, *Beaman et al. 10447* (K); G. Kinabalu, *Clemens 27568* (BM, K, L), *Clemens 28847* (BM), *Clemens 31588* (K), *Price 218* (K), Ulu Kinunut, *Carr SFN 27170* (SING); G. Trusmadi, *Mikil SAN 41890* (K, SAN).

SAPOTACEAE

Madhuca engleri (Merr.) Vink, ***comb. nov.***

Basionym: *Payena beccarii* Engl., Bot. Jahrb. Syst. 12 (1890), *nom. illeg.*, *non Payena beccarii* Pierre, Bull. Mens. Soc. Linn., Paris (1885) 525; *Payena engleri* Merr., *nom. nov.*, J. As. Soc. Str. Br., Spec. No. (1921) 477. **Type:** *Beccari PB 1598*, Borneo, Sarawak, Kuching (holotype FI; isotypes K, P). **Synonym:** *Madhuca beccarii* (Engl.) H.J.Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 177, P. Royen, Blume 10 (1960) 52.

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MNDTS

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FJ

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PMK

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FTSB

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TBS

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EPMP

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TS

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CLBD

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WSTM

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FM

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TBSA-EK

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TNB

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OFMSP

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TFPF

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EB

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TFM

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MFFSS

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MPESA

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FMP

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DFPF

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DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	Abbreviation	Word	Abbreviation
Central	C	Bukit	Bt.
Division	Div.	Gunung	G .
East	E	Kampung	Kg.
Forest Reserve	FR	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mount	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R .		
South	S		
South-West	SE		
South-West	SW		
West	W		

INDEX TO SCIENTIFIC NAMES

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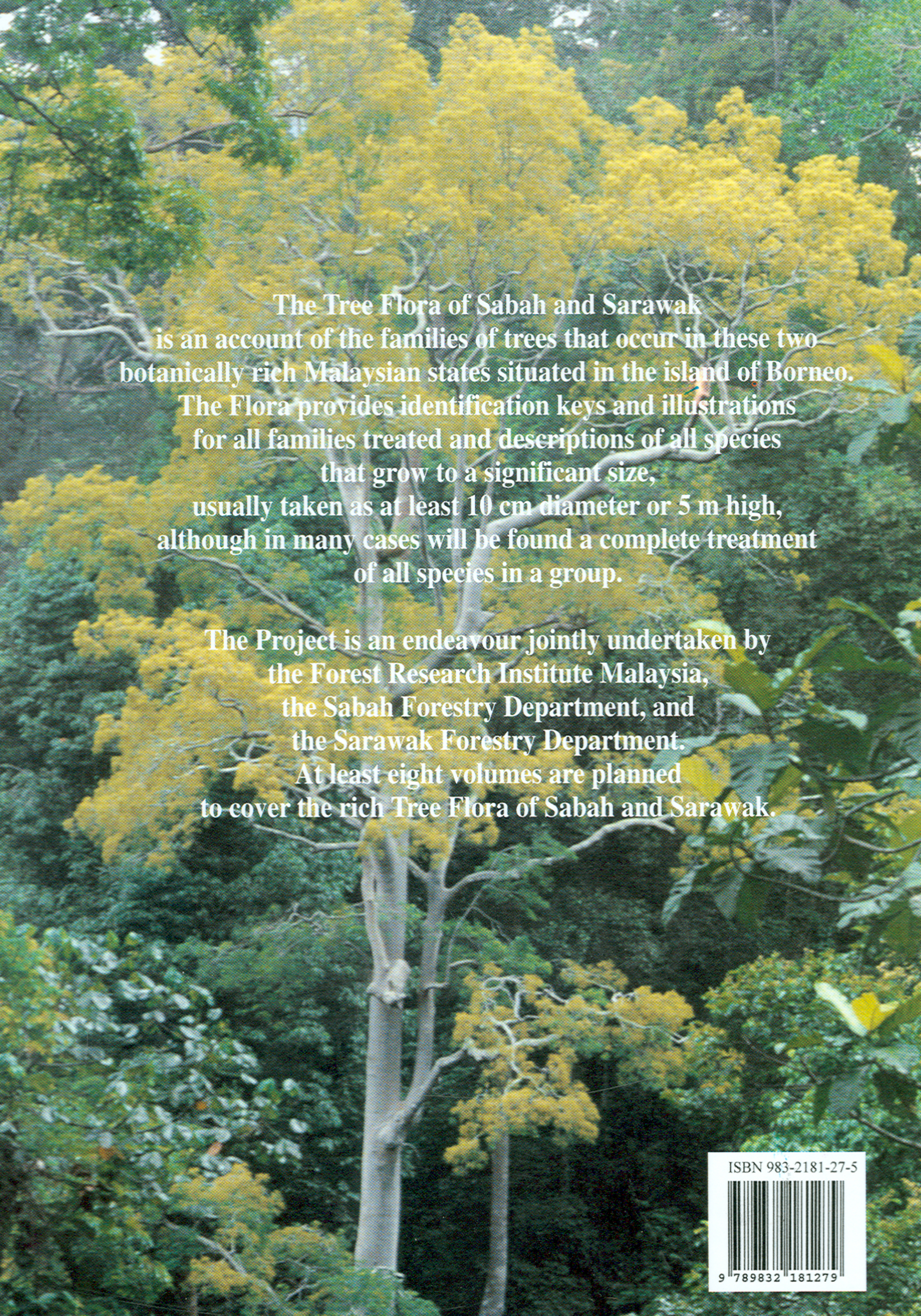

The Tree Flora of Sabah and Sarawak
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